APPENDIX I

METHODOLOGY FOR CALCULATING MASS-LOAD BASED TMDLs FOR IMPAIRED BEACHES AND CREEKS AND ALLOCATING ~~TMDLs~~ TO SOURCES

I.1 Introduction

This appendix describes the methodology for calculating the mass-load based Total Maximum Daily Loads (TMDLs) for impaired beaches and creeks and allocating the allowable bacteria loads to sources in each watershed. Calibrated and validated models were used to calculate "~~E~~existing" bacteria mass loads and "allowable" bacteria mass loads (i.e., TMDLs) ~~were first calculated~~ in each watershed ~~with the use of computer models~~ under a set of critical conditions. Because the climate in southern California has two distinct hydrological patterns (wet and dry), two modeling approaches were developed for estimating bacteria loads. ~~Additionally, TMDLs were calculated using interim and final phase numeric targets for both wet and dry weather.~~

In the San Diego Region, storms tend to be episodic and short in duration, and characterized by rapid wash-off and transport of very high bacteria loads from all land use types. The wet weather modeling approach used for ~~TMDL~~ calculation of existing loads and TMDLs was USEPA's Loading Simulation Program in C++ (LSPC). LSPC was used to estimate bacteria loading from streams and assimilation within the waterbodies, and specifically quantified loading during wet weather events, defined as 0.2 inches of rain and the 72 hours that follow.~~–~~ LSPC is a recoded C++ version of the USEPA's Hydrological Simulation Program–FORTRAN (HSPF) that relies on fundamental (and USEPA-approved) algorithms. A complete discussion of LSPC configuration, calibration, and application is provided in Appendix J.

In contrast, bacteria loading under dry weather conditions was found to be much smaller in magnitude, did not occur from all land use types, and exhibited less variability over time. To represent the linkage between source contributions and in-stream response, a steady-state mass balance model was developed to simulate transport of bacteria in the impaired creeks and the creeks flowing to impaired shorelines. This predictive model represented the streams as a series of plug-flow reactors, with each reactor having a constant, steady-state flow and bacteria load. A complete discussion of the development of the empirical framework for estimating watershed loads, and a description of the configuration and calibration of the stream-modeling network is provided in Appendix K. In addition to estimating current loading, both models were used to estimate TMDLs for the two climate conditions for each watershed. Assumptions made for both wet weather and dry weather modeling can be found in Appendix L.

This appendix describes the methodology for calculating existing loads and TMDLs using the wet and dry weather modeling results~~, and using interim and final numeric targets~~. Section I.2 of this appendix describes the ~~interim and final~~ numeric targets that were used to calculate ~~both~~ wet weather and dry weather TMDLs. Section I.3 discusses the use of load-duration curves, which were instrumental in calculating wet weather TMDLs from model output. Section I.4 discusses the derivation of ~~interim~~ wet weather TMDLs and allocations. ~~Section I.5 discusses the~~

derivation of final wet weather TMDLs and allocations. Section I.56 discusses the derivation of interim and final dry weather TMDLs and allocations.

In all cases, bacteria sources were quantified by land-use type since bacteria loading can be highly correlated with land-use practices. For purposes of implementation, land use practices were grouped according to the most likely method of regulation by the San Diego Water Board of bacteria discharges from the land use type.

I.2   Numeric Target Selection for Wet Weather and Dry Weather TMDLs

When calculating TMDLs, numeric targets must be established selected to be able to meet water quality standards (i.e., water quality objectives (WQOs) and subsequentlythat ensure the protection of beneficial uses). The numeric targets used inselected for these TMDL calculations were equal to are based primarily on the numeric WQOs for bacteria for the REC-1 (water-contact recreation (REC-1) beneficial uses. Numeric targets applicable to beaches were also used for impaired creeks for the reasons discussed in section 4 of the Technical Report.

Different dry weather and wet weather numeric targets were used because the bacteria transport mechanisms to receiving waters are different under wet and dry weather conditions. Single sample maximum WQOs were used asincluded in the wet weather numeric targets because wet weather, or storm flow, is episodic and short in duration, and characterized by rapid wash-off and transport of high bacteria loads, with short residence times, from all land use types to receiving waters. Geometric mean WQOs were used asincluded in the numeric targets for dry weather periods because dry weather runoff is not generated from storm flows, is not uniformly linked to every land use, and is more uniform than stormflow, with lower flows, lower loads, and slower transport, making die-off and/or amplification processes more important.

Another difference between the wet weather and dry weather TMDL calculations, besides the use of single sample maximum WQOs versus geometric mean WQOs, is the allowable exceedance frequency of the WQO. that the wet weather TMDLs (during the interim period, only) are calculated The allowable exceedance frequency that is based on using a reference system approach. The purpose of the reference system approach is to account for the natural, and largely uncontrollable sources of bacteria (e.g., bird and wildlife feces) in the wet weather loads generated in the watersheds and at the beaches that can, by themselves, cause exceedances of WQOs.

The reference system approach is utilized included in the numeric target for the wet weather TMDL calculations by allowing a 22 percent exceedance frequency of the single sample WQOs for REC-1. Twenty-two percent is the frequency of exceedance of the single sample maximum WQOs measured in a reference system in Los Angeles County.[1] A reference system is a beach

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[1] In the calculation of the wet weather TMDLs, the San Diego Regional Board chose to apply the 22 percent allowable exceedance frequency as determined for Leo Carillo Beach in Los Angeles County. At the time the wet weather watershed model was developed, the 22 percent exceedance frequency from Los Angeles County was the only reference beach exceedance frequency available. The 22 percent allowable exceedance frequency used to calculate the wet weather TMDLs is justified because the San Diego Region watersheds' exceedance frequencies will likely be close to the value calculated for Leo Carillo Beach, and is consistent with the exceedance frequency that was applied by the Los Angeles Regional Board.

and upstream watershed that are minimally impacted by anthropogenic activities. A reference system typically has at least 95 percent open space.

The final wet weather TMDLs must meet WQOs in the receiving water without application of a reference system approach because, at this time, the Water Quality Control Plan for the San Diego Basin (Basin Plan) does not authorize the implementation of single sample bacteria WQOs using this approach. A Basin Plan amendment authorizing implementation of single sample bacteria WQOs using a reference system approach is being developed by the San Diego Water Board[2] under a separate effort from this TMDL project.

In contrast to wet weather, implementing the dry weather numeric targets with a reference system approach is not appropriateinclude an allowable exceedance frequency of zero percent. This is because available data show that exceedances of geometric mean WQOs in local reference systems during dry weather conditions are uncommon (see Technical Report, section 4.2). Furthermore, reference systems do not generate significant dry weather bacteria loads because flows are minimal. During dry weather, flow, and hence bacteria loads, are largely generated by urban non-storm water runoff, which is not a product of a reference system. Therefore, a zero percent allowable exceedance frequency is included in the numeric targets for the dry weather TMDL calculations.A reference system approach is not applicable to dry weather TMDL calculation because numeric targets are based on the geometric mean WQOs. A reference system approach uses an allowable exceedance frequency—meaning the number of times the *single sample maximum* WQOs are exceeded in a reference system—to calculate TMDLs. An allowable exceedance frequency is not relevant to a geometric mean because the geometric mean is an average value over the course of 30 days.

I.3   Using Load Duration Curves to Calculate Wet Weather Mass-Load Based TMDLs

For the wet weather analysis, "existing" loads and TMDLs were calculated using output from the LSPC watershed model. The existing loads calculated by the LSPC model are the bacteria loads that are expected to be discharged from the watershed under the a set of critical conditions that are currently causing the bacteria impairments (i.e., worst case loading scenario). The TMDLs calculated by the LSPC model are the bacteria loads that can be discharged from the watershed and will not cause the numeric targets (numeric WQOs and allowable exceedance frequency) to be exceeded on more than the allowable exceedance frequency of the wet daysunder the same set of critical conditions and still meet the WQOs that are protective of the REC-1 beneficial use. The difference between the existing load and the TMDL is the bacteria load reduction that is required to restore the REC-1 beneficial use of an impaired waterbody and still account for natural, and largely uncontrollable sources of bacteria (e.g., bird and wildlife feces) in the wet weather loads.

To ensure that WQOs the numeric targets are met in impaired waterbodies during wet weather events, a critical period associated with extreme wet conditions was selected for TMDL calculations. Extreme wet conditions have the highest wet weather flows and bacteria loads. The year 1993 was selected as the critical wet period for assessment of extreme wet weather loading conditions because this year was the wettest year of the 12 years of record (1990 through

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[2] This Basin Plan issue ranked seventh on the 2004 Triennial Review list of priority projects.

2002) evaluated in the TMDL analysis. This corresponds to the 92nd percentile of annual rainfalls for those 12 years measured at multiple rainfall gages in the San Diego Region.

Model output was used to produce load-duration curves, such as the one shown in Figure I-1. Load-duration curves are bar graphs that display information for a specific watershed mouth (watersheds were delineated into smaller subwatersheds for loading analysis). In other words, each subwatershed has a unique load-duration curve. The y-axis shows the bacteria load (billion most-probable-number per day, or billion MPN/day) associated with the flow for a given day. Each daily wet weather load is represented by a bar. The bars are ranked across the x-axis according to the magnitude of the associated daily flow from lowest to highest. Appendixees O and P shows the load-duration curves for each modeled subwatershed, for each type of bacteria. Appendix O shows load-duration curves associated with interim numeric targets, which incorporate the reference system approach, while Appendix P shows load-duration curves associated with final numeric targets, which do not incorporate the reference system approach. Figure I-1 shows model-calculated fecal coliform loads for one of the Aliso Creek subwatersheds (identified as subwatershed number 202) in the Aliso HSA watershed (which consists of subwatersheds 201 and 202).

The Ddaily bacteria loads (each yellow blue bar) are is equal to the modeled average daily flow for the wet day times the average daily bacteria density for that day.   The height of the blue bars indicates the most probable number of fecal coliform colonies corresponding to the flow on a given day. The dark line running across the bar graph (is referred to as the "load capacity curve" or "numeric target line." or "load capacity curve.") represents the applicable WQO. The y-value of the numeric target line at any point on the graph represents the total maximum bacteria load that would not result in an exceedance of the WQO for the flow on that day. The summation of the loads below the numeric target line represents the loading capacity of the waterbody on an annual basis that will not cause numeric targets to be exceeded.
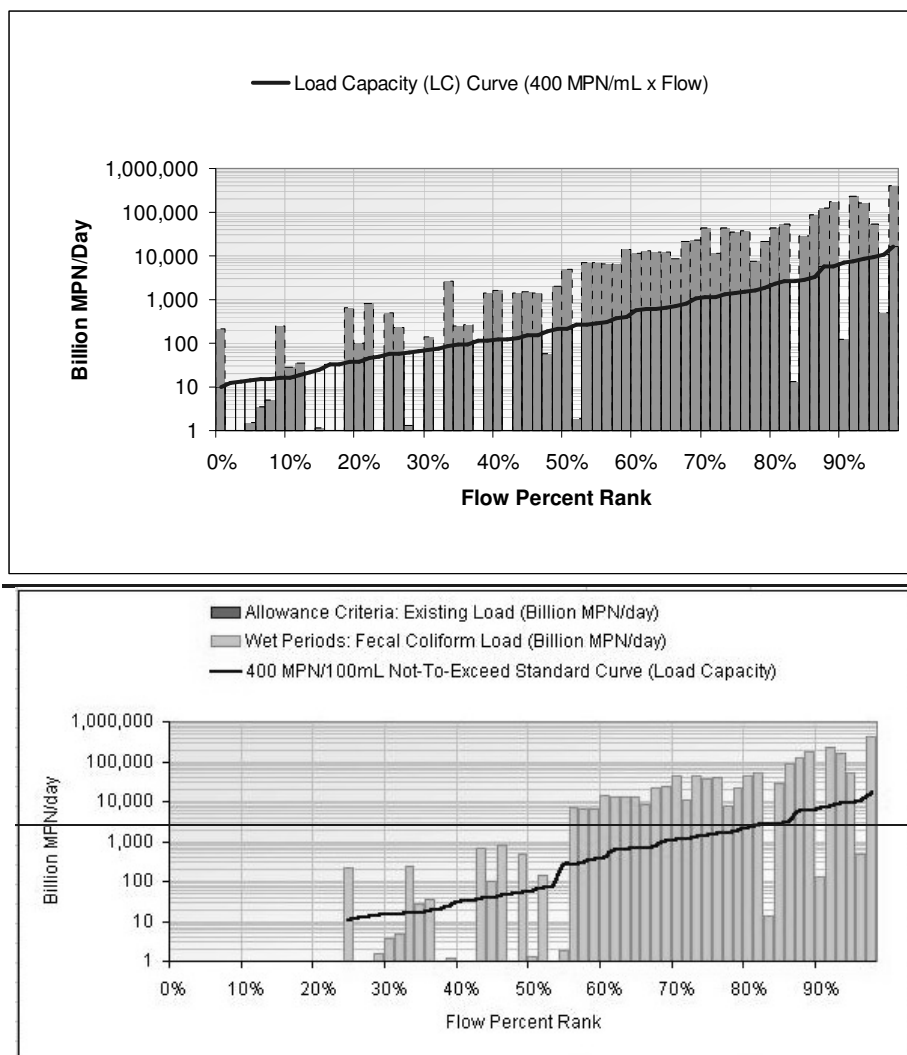
*Figure I-1. Load Duration Curve for Aliso ~~Creek~~ HSA Subwatershed # 202*

The y-value of the numeric target line at any point on the graph represents the total maximum bacteria load that would not result in an exceedance of the WQO for the flow on that day. The summation of the loads represented by the solid-line outlined bar segments below the numeric target line represents the loading capacity of the waterbody on an annual basis that will not cause numeric WQO to be exceeded. The dashed-line outlined bar segments above the numeric target line represent the bacteria load that is exceeding the load capacity based on the WQO on each wet day. For some wet days, the existing bacteria load (blue bar) is below the numeric target line, indicating the load on that day would not cause an exceedance in the WQO.

Load-duration curves are useful for quantifying the total load for existing conditions (during the critical period), and the allowable loads (TMDLs) that must not be exceeded in order to attain WQOs~~. The portions of the bars that exceed the numeric target line represent loads that are in excess of the TMDL, and must be reduced by dischargers~~to and restore the REC-1 beneficial use of an impaired waterbody. Section I.4 shows how load-duration curves were used to calculate

TMDLs using interim numeric targets (numeric WQOs and allowable exceedance frequencies)and section I.5 shows how load-duration curves were used to calculate TMDLs using final numeric targetsthe reference system approach. In all the wet weather analyses, existing loads and TMDLs are expressed on a yearly basis (billion MPN/year) because of the extremely high daily variability in storm flow magnitude and loading in the watersheds addressed by these TMDLs. The variability in the modeled daily loads is evident in the load duration curves in Appendixees O and P.

I.4   Calculation of Interim Wet Weather Mass-Load Based TMDLs and Allocations

As mentioned previously, interim wet weather TMDLs for recreational uses incorporated the reference system approach. Since storm flow loading in reference watersheds causes exceedances of single sample maximum WQOswater quality objectives, TMDLs for urban watersheds should allow the single sample WQOs to be exceeded at the same frequency as in a similar reference system. Load duration curves were used to calculate allowable exceedance loads from allowable exceedance days for interim wet weather TMDLs. A load-duration curve showing the application of the reference system approach is shown in Figure I-2.
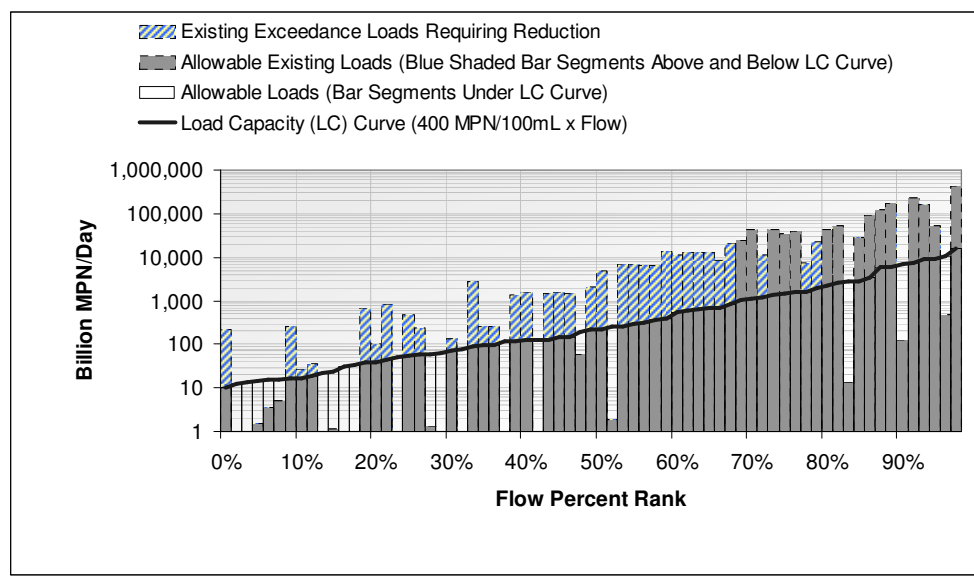
Subwatershed 202 Fecal Coliform Loading Summary	Value	Units
Total Wet Days During Critical Wet Year	69	Days
Total Wet Exceedence Days (Number of Bars with Segment Above LC Curve)	49	Days
Allowable Wet Weather Exceedance Frequency	22	Percentage
Allowable Wet Exceedance Days (Total Wet Days x Exceedance Frequency)	15	Days
Non-Allowable Wet Exceedance Days Requiring Load Reduction	34	Days
Total Existing Load for Existing Condition (Sum of All Shaded Bar Segments)	**1,732,709**	**Billion MPN/Year**
Allowable Load (Sum of Solid Outline Bar Segments Under LC Curve)	83,999	Billion MPN/Year
Allowable Exceedance Load (Sum of Blue Shaded Bar Segments Above LC Curve)	1,478,595	Billion MPN/Year
Total Allowable Load [TMDL] (Sum of Allowable Load and Allowable Exceedance Lo-	**1,562,594**	**Billion MPN/Year**
Exceedance Load Requiring Reduction (Total Existing Load - Total Allowable Lo	**170,116**	**Billion MPN/Year**
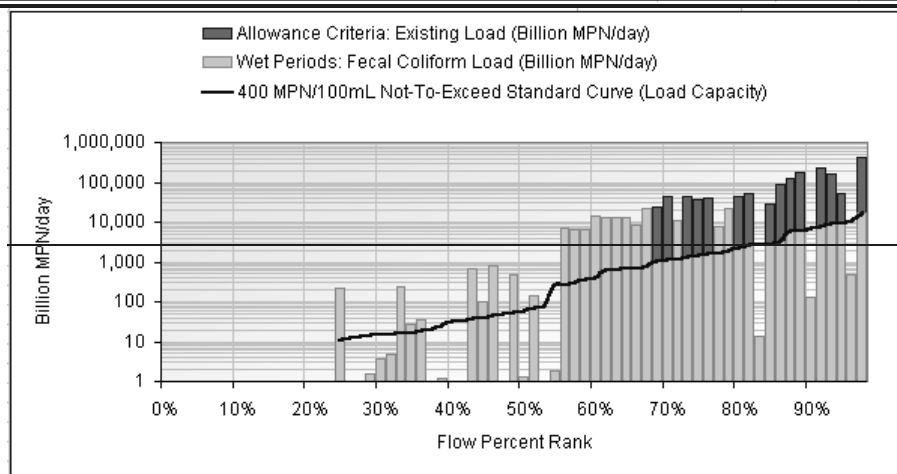
Fecal Coliform Loading Summary	Value	Units
Wet Day Exceedances	49	None
Allowable Wet Day Exceedances	15	None
Excess Wet Day Exceedances	34	None
Total Load for Existing Condition (Total Load)	1,732,709	Billion MPN/Year
Non-allowable Exceedance Load (Exceedance Load)	170,116	Billion MPN/Year
Allowable Load = (Total Load - Exceedance Load)	1,562,594	Billion MPN/Year
Percent Reduction Required from Existing Condition	**9.8%**	**Percentage**

Figure I-2. Load Duration Curve for Aliso ~~Creek~~ HSA Subwatershed #202
Using Reference ~~s~~System Approach

~~Allowable exceedance loads calculated using the reference system exceedance frequency of 22 percent are represented by the blue shadedpatterned portions of the blue bars in the load duration curve.~~ The methodology for calculating and allocating the wet weather TMDLs for each watershed using the reference system approach is described in the following steps:

Step 1. Quantify Total Existing Wet Weather Loads~~Allowable Exceedance Loads~~;
Step 2. Quantify Allowable Loads~~Existing Bacteria Loads and TMDLs~~;
Step 3.   Quantify Allowable Exceedance Loads;
Step 4.   Quantify Wet Weather TMDLs;
Step 5.   Classify Land Use Types as Point and Nonpoint Sources, and Classify Nonpoint Sources as Controllable or Uncontrollable;
Step 64. ~~–~~Quantify Relative Contribution of Bacteria Loads From Each Land Use Type;
Step 75. ~~–~~Separate Caltrans Existing Loads from Loads Generated by Industrial/Transportation Land Use;

    Step 86. ~~-~~Combine Land Use Types Based on Method of Regulation by the San Diego
          Water Board; and
    Step 97. Distribute TMDL Among Four Discharger/Land Use Categories.

~~Step 1 shows the methodology used to account for allowable exceedance loads based on the frequency of exceedance of WQOs at a reference system. Step 2 shows how information from the load-duration curves is extracted to quantify current bacteria loads and TMDLs. Steps 3-5 show how existing loads are quantified from identified sources. Steps 6-7 show how the TMDLs are distributed among discharge categories.~~Steps 1 through 4 use the information provided by load-duration curves. Steps 5 through 9 are determined based on land use data. Descriptions of each step are provide below. Sample calculations are provided showing all the steps involved.

1. Quantify Total Existing Wet Weather Loads
As discussed in section I.3, the output from the LSPC model was used to predict bacteria loading from each watershed for the critical wet period in 1993. Model-predicted loads were used to construct load-duration curves for each of the three indicator bacteria. Figure I-1, above, is a sample load-duration curve that shows model-calculated fecal coliform loads for subwatershed 202 in the Aliso HSA watershed.

The load-duration curves are bar graphs that rank the modeled flows into percentiles, or groups arranged in increasing orders of magnitude. The height of the blue bars indicates the number of bacteria colonies corresponding to the flow volume on a given day. The summation of all the blue bar segments represents the total existing annual bacteria load for wet weather in the critical wet period of 1993.

2. Quantify Allowable Loads
The dark line running across the bar graph (referred to as the "numeric target line" or "load capacity curve") in Figures I-1 and I-2 represents the total maximum bacteria load that would not result in an exceedance of the numeric WQO for the flow volume on that day. In the case for Figures I-1 and I-2, the wet weather numeric WQO is the single sample maximum REC-1 WQO for fecal coliform, which is 400 MPN/100mL (see section 4 of the Technical Report). The load capacity curve is calculated by multiplying the numeric WQO by the total flow volume for each day. So, if the daily flow volume increases, the target daily load will increase; but the numeric target stays constant.

The solid-line outlined bar segments below the numeric target line represent the loading capacity of the waterbody that will not cause the numeric WQO (i.e., REC-1 WQO) to be exceeded for each day. The summation of the solid-line outlined bar segments below the numeric target line is total allowable annual bacteria load for wet weather in the critical wet period of 1993, based only on the numeric WQOs.

3. Quantify Allowable Exceedance Loads
   ~~1.Quantify Allowable Exceedance Loads~~
Because natural, and largely uncontrollable sources of bacteria (e.g., bird and wildlife feces) in the wet weather loads generated in the watersheds and at the beaches can, by themselves, cause exceedances of WQOs, allowable exceedance loads were calculated and incorporated into the

wet weather TMDLs. A Basin Plan amendment (Resolution No. R9-2008-0028) was adopted by the San Diego Water Board authorizing the development of indicator bacteria TMDLs that account for exceedances of bacteria WQOs due to bacteria loads from natural uncontrollable sources.[3]

The first step was to identify an appropriate allowable exceedance frequency. The allowable exceedance frequency is determined by identifying an appropriate reference system. A reference system is a beach and upstream watershed that are minimally impacted by anthropogenic activities, typically having at least 95 percent open space.. To be consistent with the Los Angeles Water Board, in the calculation of the wet weather TMDLs the San Diego Water Board chose to apply the 22 percent allowable exceedance frequency as determined for Leo Carillo Beach in Los Angeles County.[4]

The next step is to quantify the allowable exceedance load associated with a 22 percent exceedance frequencytly. The allowable exceedance frequency was converted into allowable exceedance days. ~~The blue-colored portions of the bars (above the numeric target line) in Figure I-2 correspond to the 22 percent exceedance frequency allowed for loading from uncontrollable sources. The blue bars above the lines represent the reference system loading capacity of the waterbody on an annual basis that will not cause the numeric targets to be exceeded on more than 22 percent of the wet days (this was the observed exceedance frequency in the reference system). The portions of the bars below the numeric target line plus the blue portions of the bars above the numeric target line are equal to the allowable loads, or total maximum annual wet weather loads, for the subwatershed.~~

The number of allowable exceedance days for each subwatershed was calculated as follows. For each watershed, the number of wet days in 1993 was documented ~~(Technical Report, Table 8-1)~~. Wet days are defined as days with 0.2 inches or more of rainfall and the following 72 hours. For each watershed, the number of wet days in 1993 is presented Table I-1.

Table I-1. Wet Days of the Critical Period (1993) Identified for Watersheds Affecting Impaired Waterbodies

Watershed	Number of Wet Days in 1993
San Joaquin Hills HSA/Laguna Beach HSA	69
Aliso HSA	69
Dana Point HSA	69
Lower San Juan HSA	76
San Clemente HA	73
San Luis Rey HU	90

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[3] Resolution No. R9-2008-0028, *Implementation Provisions for Indicator Bacteria Water Quality Objectives to Account for Loading from Natural Uncontrollable Sources Within the Context of a TMDL,* adopted by the San Diego Water Board on May 14, 2008, approved by the State Water Board on March 17, 2009, approved by OAL on June 25, 2009, and approved by USEPA on September 16, 2009.

[4] The Los Angeles Water Board used the Arroyo Sequit Watershed as the reference system watershed for development of TMDLs for the Santa Monica Bay beaches and Malibu Creek (Los Angeles Water Board, 2002 and 2003). This watershed, consisting primarily of unimpacted land use (98 percent open space), discharges to Leo Carillo Beach, where 22 percent of wet weather fecal coliform data (10 out of 46 samples) were observed to exceed the WQOs).

San Marcos HA	49
San Dieguito HU	98
Miramar Reservoir HA	94
Scripps HA	57
Tecolote HA	57
Mission San Diego HSA/Santee HSA	86
Chollas HSA	65

The number of days that exceedances of numeric targets are allowed for each particular
watershed is obtained by multiplying the number of wet days by the exceedance frequency
(Table 8-2). For example, the Aliso Creek HSA watershed had 69 wet days in 1993. The
allowable exceedance frequency of the wet weather numeric targets under the reference system
approach is 22 percent. Therefore, the number of allowable exceedance days for the Aliso Creek
HSA watershed is:

69 Wet Days * 0.22 = 15 Allowable Exceedance Days

The number of allow exceedance days for each watershed is presented Table I-2.

Table I-2. Allowable Exceedance Days for Watersheds
Affecting Impaired Waterbodies

Watershed	Number of Allowable Exceedance Days
San Joaquin Hills HSA/Laguna Beach HSA	15
Aliso HSA	15
Dana Point HSA	15
Lower San Juan HSA	17
San Clemente HA	16
San Luis Rey HU	20
San Marcos HA	11
San Dieguito HU	22
Miramar Reservoir HA	21
Scripps HA	13
Tecolote HA	13
Mission San Diego HSA/Santee HSA	19
Chollas HSA	14

The allowable exceedance load was calculated by summing the loads above the numeric target
line for the allowable exceedance days. These loads are shown as blue portions of the bars above
the numeric target line on the load-duration curves. The 15 days with the highest loads were
chosen as the allowable exceedance days because the highest loads in most of the watersheds
correspond to open space land uses where bacteria loads are generated from natural sources.
The remaining orange portions of the bars with magnitudes above the numeric target line
represent exceedance loads that must be reduced Using the chart associated with Figure I-2, the
allowable load, or TMDL, is equal to the Total Load for Existing Conditions minus the Non-
Allowable Exceedance Loads caused by anthropogenic sources (orange portions of the bars
above the numeric target line). For this particular subwatershed, the Allowable Load is
quantified in the chart associated with Figure I-2 as 1,562,594 billion MPN/year.

The days with the highest loads were chosen as the allowable exceedance days because the highest loads in most of the watersheds correspond to open space land uses where bacteria loads are generated from natural sources. The solid blue bar segments above the numeric target line shown on the example load-duration curve in Figure I-2 correspond to the 22 percent exceedance frequency allowed for loading from uncontrollable sources. The number of solid blue bar segments above the numeric target line is equal to the allowable exceedance days shown in Table I-2. For the Aliso HSA watershed, there are 15 allowable exceedance days, which correspond to the 15 solid blue bar segments above the numeric target line shown in Figure I-2.

The solid blue bar segments above the numeric target lines represent the reference system loading capacity of the waterbody that will not cause the numeric targets to be exceeded on more than 22 percent of the wet days. The summation of the solid blue bar segments above the numeric target line is the total allowable annual bacteria exceedance load for wet weather in the critical wet period of 1993.

4.   Quantify Wet Weather TMDLs
The solid-line outlined bar segments below the numeric target line plus the solid blue bar segments above the numeric target line are equal to the total allowable bacteria loads, or total maximum annual wet weather bacteria loads, for the subwatershed. In other words, the sum of the allowable loads calculated under step 2 and the allowable exceedance loads calculated under step 3 is equal to the TMDL for the subwatershed.

The existing loads and TMDLs for each watershed are calculated by summing the existing loads and TMDLs of all the modeled subwatersheds in each watershed.

    2.Quantify Existing Bacteria Loads and TMDLs
Just as the allowable exceedance loads were quantified in step 1, the total existing loads, including those from anthropogenic sources, can also be found from load-duration curves. An example showing the quantification of the existing fecal coliform load and TMDL for the Aliso Creek watershed is shown below.

For example, Tthe total existing bacteria load from the Aliso Creek HSA watershed is comprised of loads from subwatershed numbers 201 and 202 (these two subwatersheds are adjacent to the Pacific Ocean and are cumulative of the upstream watersheds). Numerical values were obtained from the charts associated with the load-duration curves for the Aliso Creek HSA watershed, specifically Tables O-16 and O-19 (Appendix O) for this example. The "Total Existing Load For Existing Condition" (Total Existing Load) and the TMDL for the Aliso Creek HSA watershed is the sum of the "Total Existing Load for Existing Conditions" for subwatersheds 201 and 202 from Tables O-16 and O-19, respectively. The "TMDL" for the Aliso Creek HSA watershed is the sum of the "Total Allowable Load [TMDL]" (Allowable Load) for subwatersheds 201 and 202 from Tables O-16 and O-19, respectively. The Total Load and the TMDL for the Aliso Creek HSA watershed are calculated in the following equations.

$$\text{Existing Load} = (\text{Existing Load})_{\text{Subwatershed 201}} + (\text{Existing Load})_{\text{Subwatershed 202}}$$
$$= 19{,}386 \text{ billion MPN/mL} + 1{,}732{,}709 \text{ billion MPN/mL}$$

$$= 1{,}752{,}095 \text{ billion MPN/mL}$$

TMDL $\quad$ = (Allowable Load)$_{\text{Subwatershed 201}}$ + (Allowable Load)$_{\text{Subwatershed 202}}$

$$= 16{,}480 \text{ billion MPN/mL} + 1{,}562{,}594 \text{ billion MPN/mL}$$
$$= 1{,}579{,}074 \text{ billion MPN/mL}$$

The same calculations were performed for each watershed by summing the "Total Existing Load for Existing Condition" and "Total Allowable Load [TMDL]," respectively, of all the modeled subwatersheds in each watershed. Table I-31 shows the interim wet weather existing loads and TMDLs on an annual basis for all major watersheds included in this project for fecal coliform, total coliform, and enterococci bacteria, which were derived from the load-duration curves in Appendix -O.

Table I-31. Interim Wet Weather Existing Loads and TMDLs (Billion MPN/Year)

Watershed	Fecal Coliform		Total Coliform		Enterococci	
	Existing	**TMDL**	**Existing**	**TMDL**	**Existing**	**TMDL**
San Joaquin Hills HSA/Laguna Beach HSA	705,015	664,634	8,221,901	7,445,649	852,649	782,799
Aliso HSA	1,752,095	1,579,073	23,210,774	20,190,798	2,230,206	1,950,964
Dana Point HSA	403,911	377,313	6,546,962	6,031,472	501,526	462,306
Lower San Juan HSA	15,304,790	14,714,833	130,258,863	122,879,189	12,980,098	12,152,446
San Clemente HA	1,441,723	1,378,931	16,236,606	15,147,603	1,663,100	1,563,187
San Luis Rey HU	33,120,012	32,444,242	231,598,677	224,150,535	18,439,920	17,463,618
San Marcos HA	20,886	17,224	515,278	425,083	40,558	32,966
San Dieguito HU	21,286,910	21,101,649	163,541,133	159,814,184	14,796,210	14,307,087
Miramar Reservoir HA	10,392	10,256	212,986	210,180	11,564	11,405
Scripps HA	204,057	176,907	5,029,519	4,356,973	377,839	324,032
Tecolote HA	261,966	229,322	7,395,789	6,379,770	708,256	603,761
Mission San Diego HSA/Santee HSA	4,932,380	4,680,838	72,757,569	66,105,222	7,255,759	6,590,966
Chollas HSA	603,863	520,440	15,390,608	13,247,626	1,371,972	1,152,645

Laguna/San Joaquin	664,634	7,445,650	782,798
Aliso Creek	1,579,074	20,190,798	1,950,980
Dana Point	377,313	6,031,472	462,306
San Juan Creek	14,714,833	122,879,189	12,152,446
San Clemente	1,378,930	15,147,590	1,563,186
San Luis Rey River	32,445,470	224,189,156	17,470,687
San Marcos	17,224	425,083	32,966
San Dieguito River	21,106,683	159,978,672	14,327,364
Miramar	10,256	210,182	11,405
Scripps	176,906	4,356,972	324,033
San Diego River	4,681,150	66,114,283	6,591,843
Chollas Creek	520,440	13,247,626	1,152,645

The difference between the existing load and TMDL is represented by the sum of the patterned bar segments above the numeric target line. The patterned bar segments above the numeric

target line represent the bacteria loads that are in exceedance of the numeric target (i.e., REC-1 WQOs and allowable exceedance frequency) that must be reduced to meet the TMDL.

3.5.Classify Land Use Types as Point or Nonpoint Sources, and Classify Nonpoint Sources as Controllable or Uncontrollable

For purposes of TMDL allocation to sources, all land use types were classified based on whether or not they generated mainly point or nonpoint sources of bacteria. Nonpoint source land use categories were further divided into controllable or uncontrollable sources. The classification of a land use as generating either point or nonpoint sources was based on the likelihood that the land use was urban and would occur in an area drained by municipal separate storm sewer systems (MS4s), or was rural and outside of MS4 drained areas. The rationale for identifying specific responsible dischargers is discussed in the Technical Report, sections 10 and 11.

Point sources are defined as "any discernable, confined and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft, from which pollutants are or may be discharged" [CWA section 502(6)].
Land use types considered urban and generating mostly point source loads from storm drain discharges were identified as:

- Low Density Residential;
- High Density Residential;
- Commercial/Institutional;
- Industrial/Transportation (excluding areas owned by Caltrans);
- Caltrans;
- Military;
- Parks/Recreation; and
- Transitional (construction activities).

Bacteria loads from these land use types were classified as point sources because, although they may be diffuse in origin, these land uses are typically found in urbanized areas, and the pollutant loading is transported and discharged to receiving waters through MS4s. MS4s are considered point sources because they discharge waste out of a discrete pipe. The principal MS4s contributing bacteria to receiving waters are owned or operated by either municipalities located throughout the watersheds or the California Department of Transportation (Caltrans). Municipal and Caltrans MS4 discharges are regulated separately under different NPDES requirements. For this reason, in each watershed, loads generated by Caltrans were separated from loads generated by Municipal MS4s.

Land use types considered rural and outside of areas drained by MS4s were identified as:

- Agriculture;
- Dairy/Intensive Livestock;
- Horse Ranches;
- Open Recreation;
- Open Space; and

- Water.

Bacteria loads from these land use types were classified as nonpoint sources because bacteria-laden discharges from these land uses are diffuse in origin, and originate in areas without constructed (man-made) MS4s. Nonpoint sources were separated into controllable and uncontrollable categories. Controllable sources included those found in the following land-use types: Agriculture, Dairy/Intensive Livestock, and Horse Ranches. These were considered controllable because the land uses are anthropogenic in nature, and load reductions can be reasonably expected with the implementation of suitable management measures. For implementation purposes, controllable nonpoint source discharges are recognized as originating from activities related to agriculture, livestock, and horse ranch facilities. For this reason, these types of discharges were given load allocations (LAs) and were required to reduce their bacteria loads if they constitute more than 5 percent of the total TMDL (see step 7 for methodology for calculating LAs).

Uncontrollable nonpoint sources include loads from Open Recreation, Open Space, and Water land uses. Loads from these areas were considered uncontrollable because they come from natural sources (e.g. bird and wildlife feces) rather than anthropogenic sources. LAs from these sources were developed, but there were no accompanying load reductions expected since these sources are natural, largely uncontrollable, and regulation is not warranted.

3.6.Quantify Relative Contribution of Bacteria Loads From Each Land Use Type
The sum of all the shaded bars in the load-duration curves provides an estimate of the total load expected in each watershed during the critical condition (rainfall conditions documented in the critical period in 1993). The watershed model results were used to calculate the percent contribution from each of the 13 land use types to the total existing load (see Appendix J for discussion). Pie charts, like Figure I-3 below, shows these percentages for each watershed. Loads from each land use type were calculated by multiplying the existing load for the watershed by the percentages in the pie charts. Pie charts for each watershed are presented in Figures I-5 through I-40.
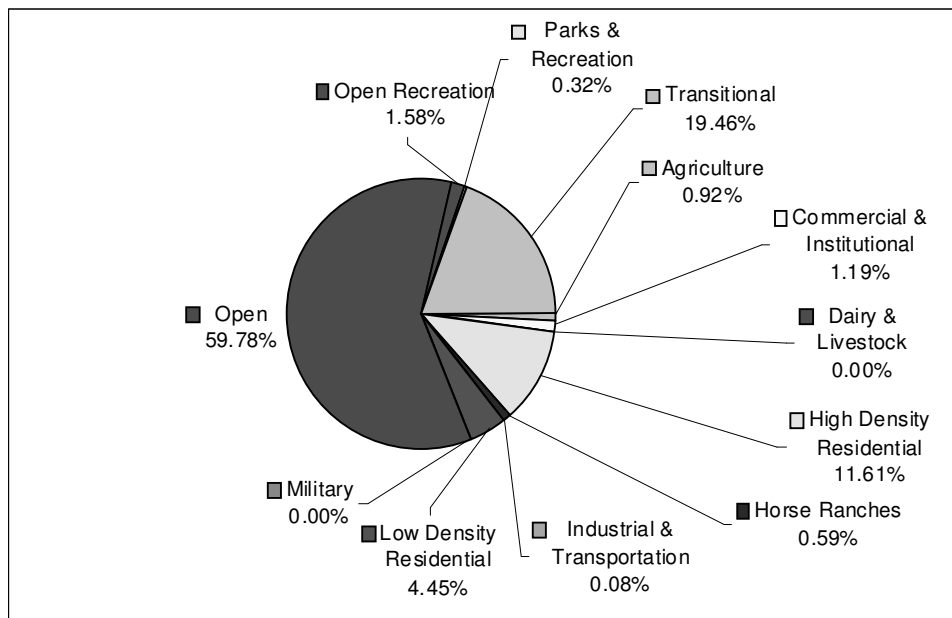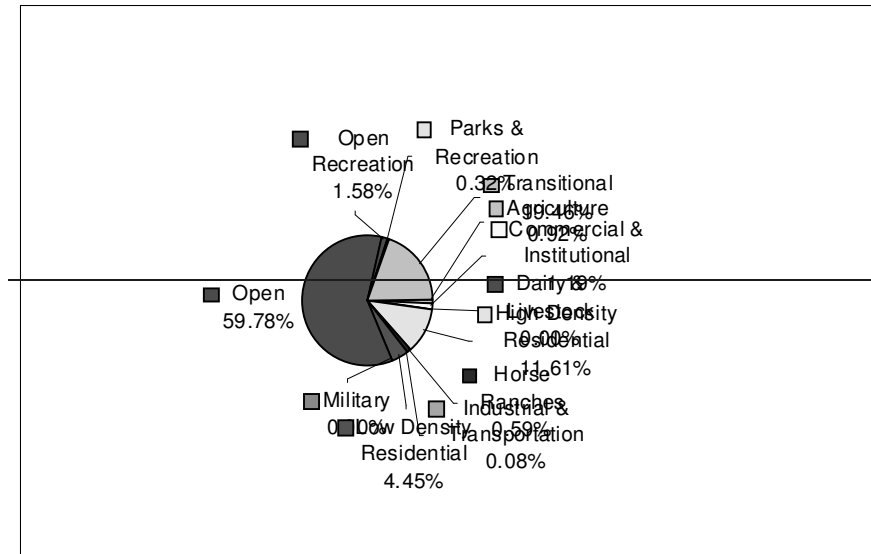
*Figure I-3. Percent of Fecal Coliform Load Generated by Different
Land Uses in the Aliso Creek HSA Watershed*

For example, the existing load from all sources to the Aliso Creek HSA watershed is 1,752,095 billion MPN/year (Table O-16, O-19, Appendix O). The relative load from the High Density Residential land use can be calculated as follows:

Existing Load from High Density Residential   = 1,752,095 billion MPN/year * 11.61%

= 203,418 billion MPN/year

Relative loads from all land use types, in all watersheds and each indicator bacteria are presented in Tables I-12 through I-14.

4.7. Separate Caltrans Existing Loads from Loads Generated by Industrial/Transportation Land Use

Highways owned by Caltrans are assumed to be lumped intopart of the industrial and transportation land use category. Bacteria loads generated from Caltrans highways need to be quantified separately from the Industrial/Transportation land use, since ultimately discharges from Caltrans highways are regulated under their own set of waste discharge requirements (WDRs) implementing National Pollutant Discharge Elimination System (NPDES) regulations. Caltrans land use areas were not delineated in the geographic information system (GIS) data used in the wet weather modeling analysis. Thus, relative loads contributed by Caltrans could not be extracted directly from the watershed model results. To calculate an existing load from Caltrans, the area occupied by impermeable Caltrans owned highway surfaces was expressed as a percent of the total area occupied by the Industrial/Transportation land use, for each watershed. The area occupied by Caltrans in each of the impaired watersheds was provided by Caltrans (Richard Watson, Caltrans, personal communication, September 23, 2005) as shown in Table I-42.

Using this information, the existing loads associated with the Industrial/Transportation land use was divided into two sources; one generated by the Municipal MS4s and one generated by

Caltrans based on the percent of the total Industrial/Transportation land use area occupied by impermeable Caltrans' highways.

Table I-42. Caltrans Occupied Areas in Each Impaired Watershed

Watershed	Caltrans Occupied Area (sq miles)
San Joaquin Hills HSA/Laguna Beach HSA	0.19
Aliso HSA	0.17
Dana Point HSA	0.06
Lower San Juan HSA	0.73
San Clemente HA	0.18
San Luis Rey HU	1.17
San Marcos HA	0.01
San Dieguito HU	0.78
Miramar Reservoir HA	0.74
Scripps HA	0.00
Tecolote HA	0.24
Mission San Diego HSA/Santee HSA	1.94
Chollas HSA	0.57

An example calculation for the Aliso Creek HSA watershed is shown below.

Industrial/Transportation land use area = 0.89 sq miles (Table J-1 in Appendix J)

Caltrans occupied area = 0.17 sq miles (Table I-42)

The percent of the Industrial/Transportation land use area that is occupied by Caltrans is:

$$\frac{0.17 \; sq \; miles}{0.89 \; sq \; miles} = 0.191 = 19.1\%$$

The existing loads generated by Caltrans were obtained by multiplying the percent area occupied by Caltrans by the loads generated by the Industrial/Transportation land use (Table I-10):

Existing Fecal Coliform   = (Percent of land use occupied by Caltrans)
Load Generated by Caltrans   * (Existing Fecal Coliform Load Generated by the
                                         Industrial/Transportation land use)
                                   = 0.191 * 1,402 billion MPN/year
                                   = 268 billion MPN/year

For three two watersheds, San Joaquin Hills HSA/Laguna Beach HSALaguna/San Joaquin, and Dana Point HSA, the Caltrans occupied area was reported as being larger than the area reported for the Industrial/Transportation land use. The Caltrans data are more current (2005) than the GIS land use data (2000), thus, the discrepancy is most likely due to new highway construction since 2000 by Caltrans in these watersheds. In these cases, the loads generated by the Industrial/ Transportation land use were attributed solely by Caltrans.

The loads generated by Caltrans calculated from the above methodology in the remaining watersheds are shown in Tables I-15 through I-17.

5.8.Combine Land Use Types Based on Method of Regulation by the
     San Diego Water Board

After the existing loads were calculated from each land use type (sources) in steps 46 and 57, the land use types were then combined into one of four discharge/land use categories. These categories were based on the manner in which discharges associated with these land uses are regulated by the San Diego Water Board. The land uses were grouped into the following four discharge categories:

Municipal MS4s   = Sum of existing loads generated from Low
                                      Density Residential, High Density Residential,
                                      Commercial/Institutional,
                                      Industrial/Transportation (excluding Caltrans),
                                      Military, Parks/Recreation, and Transitional
                                      land uses

Caltrans   = Existing load calculated from step 75

Agriculture/Livestock Operations = Sum of existing loads from Agriculture,
(Ag/Livestock)   Dairy/Intensive Livestock, and Horse Ranches
                                      land uses

Undeveloped Land   = Sum of existing loads from Open Recreation,
(Open Space)   Open Space, and Water land uses

Discharges from the various land use types were grouped into these four categories for implementation purposes. Section 11 of the Technical Report discusses implementation of the TMDLs.

6.9.Allocate TMDL to the Four Discharge/Land Use Categories

Once TMDLs were determined in step 42, they were allocated to the four discharge/land use categories described in step 86. Wasteload allocations (WLAs) were assigned to point source discharges and load allocations (LAs) were assigned to nonpoint source discharges. The wet weather TMDLs were distributed as follows:

$$TMDL = WLA(Municipal\,MS\,4s) + WLA(Caltrans) + LA(Ag\,/\,Livestock) + LA(Open\,Space)$$

where $TMDL$ = Total Maximum Daily Load for entire watershed
        $WLA\ (Municipal\ MS4s)$ = Point source Wwasteload allocation for owners/operators of
                                Municipal MS4s
        $WLA\ (Caltrans)$ = Point source Wwasteload allocation for Caltrans
        $LA\ (Ag/Livestock)$ = Nonpoint source Lload allocation for owners/operators of
                                agriculture, livestock, and horse ranch facilities land uses

> *LA (Open Space)* = Nonpoint source Lload allocation for uncontrollable sources of bacteria for open space, open recreation, and water land uses

Since loads from Open Space, Open Recreation, and Water land uses are uncontrollable, the LAs for this category cannot be lower than the existing loads. Therefore the LAs for this category are the same as the existing loads generated by uncontrollable sources, as calculated from step 64, and cannot be reduced (i.e., *Existing Load (Open Space) = LA (Open Space)*).

Similarly, for Caltrans, the WLAs are identical to the existing loads generated by Caltrans in each watershed. However, the reasoning for this determination is different than the reasoning described for loading from uncontrollable sources. Inspection of Figures I-5 through I-40 indicate that wet weather loading from the Industrial/Transportation land use is less than 1 percent of the total existing load in all watersheds. Furthermore, Caltrans occupies a portion of this land use (Tables I-15 through I-17). Since Caltrans is an insignificant bacteria source compared to other controllable sources, the San Diego Water Board shall not impose stricter regulation than what is already in place (see section 11.5.2 for a description of regulation of Caltrans with respect to these TMDLs). Therefore, no reductions are required for Caltrans . (i.e., *Existing Load (Caltrans) = WLA (Caltrans)*) The remaining portion of the TMDL is distributed between the Municipal MS4s and Ag/Livestock categories, as follows:

$$TMDL - WLA(Caltrans) - LA(Open\ Space) = WLA(Municipal\ MS4s) + LA(Ag/Livestock)$$

The methodology used for distributing the remaining portions of the TMDL between the Municipal MS4s and the Ag/Livestock categories depended on whether or not the relative bacteria loads contributed by agriculture, livestock, and horse ranch facilities (i.e., *Existing Load (Ag/Livestock)*) were significant compared to loads from urbanized areas. Although allocations are distributed to the identified dischargers of bacteria, this does not imply that other potential sources do not exist. Any potential sources in the watersheds, such as publicly owned treatment works, not receiving an explicit allocation as described above is allowed a zero discharge of bacteria to the impaired beaches and creeks.

a) Methodology When Ag/Livestock Sources are an Insignificant Portion of the Total Existing Load

Figures I-5 through I-40 demonstrate that in the San Joaquin Hills HSA/, Laguna Beach HSA, Aliso CreekHSA, Dana Point HSA, San Clemente HA, Miramar Reservoir HA, Scripps HA, San Diego RiverMission San Diego HSA/Santee HSA, and Chollas CreekHSA watersheds, the proportion of the total existing load for all 3 indicator bacteria due to agriculture, livestock, and horse ranch facilities (loads associated with Agriculture, Dairy/Intensive Livestock, and Horse Ranches land uses) is less than 5 percent. For these watersheds, the LAs for agriculture, livestock, and horse ranch facilities are identical to existing loads calculated from these land uses. As with Caltrans and Open Space, LAs are given to agriculture, livestock, and horse ranch facilities; however no load reductions are required since these sources are insignificant compared to existing loads generated by urban sources in these watersheds (ie., *Existing Load (Ag/Livestock) = LA (Ag/Livestock)*). Therefore Municipal MS4s alone are required to reduce bacteria loads during wet weather events in these watersheds to meet the TMDLs.

WLAs for municipal MS4s are given by:

$$WLA(Municipal\ MS4s) = TMDL - WLA(Caltrans) - LA(Ag/Livestock) - LA(Open\ Space)$$

In the above equation, WLAs for Caltrans, LAs for agriculture, livestock, and horse ranch facilities, and LAs for uncontrollable sources are equal to existing loads from these sources as determined in steps 64 and 75. Using the Aliso Creek HSA watershed as an example, the WLA for Municipal MS4s can be calculated using Table I-120. The WLA for fecal coliform for Municipal MS4s is

WLA (Municipal MS4s) = [1,579,0734 – 2608 – 26,508457 – 1,075,237085] billion MPN/year

= 477,069264 billion MPN/year

The percent reduction required for fecal coliform for the Municipal MS4s in the Aliso Creek HSA watershed is

$$Percent\ Reduction = \frac{(Existing\ Load\ From\ Municipal\ MS4s - WLA\ (Municipal\ MS4s))}{Existing\ Load\ From\ Municipal\ MS4s}$$

$$= \frac{(650{,}092\ billion\ MPN/year - 477{,}069\ billion\ MPN/year)}{650{,}092\ billion\ MPN/year}$$

$$= 0.2662$$
$$= 26.62\%$$

b) Methodology When Ag/Livestock Sources are a Significant Portion of the Total Existing Load

In the Lower San Juan Creek HSA, San Luis Rey RiverHU, San Marcos CreekHA, and San Dieguito RiverHU watersheds, the agriculture, livestock, and horse ranch facilities generate more than 5 percent of the total wet weather load for all three indicator bacteria. Table I-53 shows the percent contribution of bacteria from agriculture, livestock, and horse ranch facilities to the total existing load in each watershed. This information is derived from the pie charts (Figures I-5 through I-40).

Table I-53. Percent Contribution of Bacteria from Agriculture, Livestock, and
Horse Ranch Facilities to the Total Existing Loads

Watershed	Percent of Existing Load		
	Fecal Coliform	Total Coliform	Enterococci
San Joaquin Hills HSA/Laguna Beach HSA	1.04%	0.62%	0.38%0.37
Aliso HSA	1.51%	0.77%	0.50%0.51
Dana Point HSA	0.00%	0.00%	0.00%
Lower San Juan HSA	**21.40%**	**14.20%**	**8.87%**
San Clemente HA	0.03%	0.01%	0.01%
San Luis Rey HU	**62.46%**	**50.67%**	**37.32%**
San Marcos HA	**53.62%**	**23.76%**	**19.29%**
San Dieguito HU	**55.77%**	**42.53%**	**29.90%**
Miramar Reservoir HA	0.00%	0.00%	0.00%
Scripps HA	0.00%	0.00%	0.00%
Tecolote HA	0.00%	0.00%	0.00%
Mission San Diego HSA/Santee HSA	8.41%	4.80%4.81	2.94%
Chollas HSA	0.00%	0.00%	0.00%

Similarly, the percent contribution from urbanized (i.e., municipal MS4) sources for each
watershed is shown in Table I-64.

Table I-64. Percent Contribution of Bacteria from Urbanized Municipal MS4 Sources
to the Total Existing Loads

Watershed	Percent of Existing Load		
	Fecal Coliform	Total Coliform	Enterococci
San Joaquin Hills HSA/Laguna Beach HSA	11.00%	20.15%	15.98%
Aliso HSA	37.10%	51.46%	45.50%
Dana Point HSA	44.33%	59.87%	51.59%
Lower San Juan HSA	8.67%	15.29%	14.64%
San Clemente HA	17.72%	28.13%	23.79%
San Luis Rey HU	2.85%	6.58%	7.98%
San Marcos HA	38.76%	71.03%	73.44%
San Dieguito HU	3.81%	10.64%	12.92%
Miramar Reservoir HA	65.81%	81.81%	71.50%
Scripps HA	62.93%	81.92%	75.65%
Tecolote HA	60.87%	83.19%	81.29%
Mission San Diego HSA/Santee HSA	9.58%	23.97%	21.44%
Chollas HSA	55.63%	78.12%	74.51%

Owners and operators of agriculture, livestock, and horse ranch facilities in the Lower San Juan CreekHSA, San Luis Rey RiverHU, San Marcos CreekHA, and San Dieguito River HU watersheds are given required reductions that are proportional to the existing loads generated by these sources. The LAs for the Ag/Livestock category are calculated as follows:

$$LA(Ag / Livestock) = [TMDL - WLA(Caltrans) - LA(Open\ Space)] * \left[\frac{X}{Y} \right]$$

where X = _% Total Existing Load from Agriculture/Livestock/Horse land uses
(Table I-3),
and
Y = _% Total Existing Load from Agriculture/Livestock/Horse land uses
+ % Total Existing Load from Urban land uses (summation of entries from
Table I-53 and I-64)

In other words, the wasteload allocations for Caltrans and Open Space, which are equal to the existing loads for these categories and do not require reductions, are subtracted from the TMDL load. That difference ([*TMDL – WLA (Caltrans) – LA(Open Space*]) must be divided between the Ag/Livestock category and Municipal MS4 category. The ratio of the existing Ag/Livestock loading to the existing Municipal MS4 loading (the [X/Y] term in the equation) is the basis for splitting the difference between the two categories.

The variables *X* and *Y* are determined from Tables I-3 and I-4, which are in turn derived from the pie charts (Figures I-5 through I-40).

An example calculation for Lower San Juan Creek HSA watershed is shown below. The value for the TMDL is found in Table I-31. The values for the WLA (Caltrans), LA (Open Space) are equal to existing loads and are found in Table I-12. All values are specific to the Lower San Juan Creek HSA watershed.

$$LA\ (Ag/Livestock) = [14,714,833 - 1,713541 - 10,701,13109] * \left[\frac{21.4\%}{21.4\% + 8.67\%} \right]$$

$$= 2,855,570361\ billion\ MPN/year$$

The percent reduction required for fecal coliform for agriculture, livestock, and horse ranch facilities is

$$Percent\ Reduction = \frac{(Existing\ Load\ From\ Ag/Livestock - LA\ (Ag/Livestock))}{Existing\ Load\ From\ Ag/Livestock}$$

$$= \frac{(3,275,477\ billion\ MPN / year - 2,855,570\ billion\ MPN / year)}{3,275,477\ billion\ MPN / year}$$

$$= 0.1282$$
$$= 12.82\%$$

Once WLAs for agriculture, livestock, and horse ranch facilities have been determined, the remaining portion of the TMDL is allocated to Municipal MS4s. The WLAs for Municipal MS4s are given by:

$$WLA(Municipal\ MS4s) = TMDL - WLA(Caltrans) - LA(Ag/Livestock) - LA(Open\ Space)$$

Using the value for *LA (Ag/Livestock)* calculated in the previous step, *WLA (Municipal MS4s)* can be determined for the Lower San Juan Creek HSA watershed.

WLA (Municipal MS4s) = [14,714,833 – 1,713541 – 10,701,13109 – 2,855,4776,361] billion MPN/year

= 1,156,419822 billion MPN/year

Note that the formula for determining WLAs for Municipal MS4s is the same as the one described in methodology a). An important point is that the difference between the two methodologies is that in watersheds where loads from Ag/Livestock are insignificant, the LAs for this category are identical to existing loads. However, in watersheds where loads from Ag/Livestock are significant, the LAs for this category are lower than existing loads.

Table I-75 shows the WLAs, LAs, and percent reductions using interim numeric targets required for the Aliso Creek HSA and Lower San Juan Creek HSA watersheds using the methods outlined in this appendix. For the Lower San Juan HSA, San Luis Rey HU, San Marcos HA, and San Dieguito HU watershed, Tthe Municipal MS4s and Ag/Livestock categories are required to reduce the bacteria loads in each watershed by the amount specified in Figures I 41 through I 43Table I-18 through I-20.

Table I-75. Interim WLAs and LAs (Billion MPN/Year) for Fecal Coliform in the Aliso Creek and San Juan Creek Watersheds

| | | Point Sources | | | | Nonpoint Sources | | | |
| | | MS4 | | Caltrans* | | Ag/Livestock | | Open Space* | |
Watershed	TMDL	WLA	Reduction Required	WLA	Reduction Required	$\frac{X}{Y}$**	LA	Reduction Required	LA	Reduction Required
Aliso HSA	1,579,073	477,069	26.62%	260	0.00%	0.04	26,508	0.00%	1,075,237	0.00%
Lower San Juan HSA	14,714,833	1,156,419	12.82%	1,713	0.00%	0.71	2,855,570	12.82%	10,701,131	0.00%

* No reductions are required for Caltrans or Open Space
** X = % Total Existing Load from Agriculture/Livestock/Horse land uses, and Y = % Total Existing Load from Agriculture/Livestock/Horse land uses + % Total Existing Load from Municipal MS4 land uses

Watershed	TMDL	WLA (Municipal MS4)	% Reduction	WLA (Caltrans)^A	$\frac{X}{Y}$ ^B	LA (Ag/Livestock)	% Reduction	LA (Open Space)^A
Aliso Creek	1,579,074	477,264	27	268	0.04	26,457	0	1,075,085
San Juan Creek	14,714,833	1,155,872	13	1,541	0.71	2,856,311	13	10,701,109

^A No reductions are required for Caltrans or Open Space
^B X = % Total Existing Load from Agriculture/Livestock/Horse land uses, and
Y = % Total Existing Load from Agriculture/Livestock/Horse land uses

+ % Total Existing Load from Urban land uses

The information in Table I-75 (except for the values for X and Y) is available for the remaining watersheds, and for total coliform and enterococci, and is reported in Tables I-18 through I-20, as well as Tables 9-12a, 9-42b, and 9-82c in section 9 of the Technical Report.

I.5Calculation of TMDLs Using Final Numeric Targets for Wet Weather Analysis

The methodology for calculating TMDLs and allocations using final numeric targets is similar to the methodology for calculating allowable loads using interim numeric targets. The difference is that with final numeric targets, there is no application of the reference system approach, and therefore, no allowable exceedance loads. Figure I-4 shows the load-duration curve for fecal coliform for the Aliso Creek watershed, using the final numeric targets.
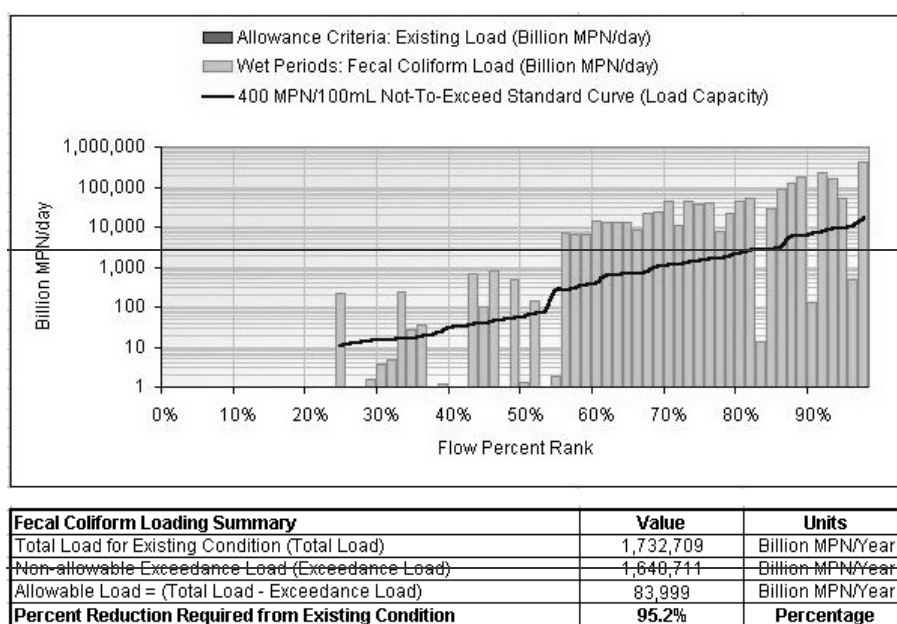

Fecal Coliform Loading Summary	Value	Units
Total Load for Existing Condition (Total Load)	1,732,709	Billion MPN/Year
Non-allowable Exceedance Load (Exceedance Load)	1,648,711	Billion MPN/Year
Allowable Load = (Total Load - Exceedance Load)	83,999	Billion MPN/Year
Percent Reduction Required from Existing Condition	95.2%	Percentage

Figure I-4. Load Duration Curve for Aliso Creek Subwatershed #202 (No Reference System Approach)

Inspection of Figures I-2 and I-4 reveal that the only difference in the graphs is that there are no allowable exceedance loads identified by blue bars. In contrast to the discussion in section I.4, all the loads in Figure I-4 with magnitudes above the numeric target line, are considered exceedance loads and must be reduced. The TMDL is now only the sum of the bars below the numeric target line.

Because the methodologies for calculating interim and final TMDLs and allocations are identical, the steps outlined in section I.4 are applicable to section I.5 and therefore not repeated. The steps shown below contain only results that differ from section I.4.

        1.Quantify Existing Bacteria Loads and TMDLs
As with interim numeric targets, the loads from the entire watershed are derived from loads calculated from each subwatershed. In this case, the loads for Aliso Creek are derived from the

load-duration curves representing subwatersheds 201 and 202. Using values from load duration curves describing fecal coliform in Aliso Creek (Tables P-16 and P-19 in Appendix P),

Total Load   = (Total Load)$_{Subwatershed\ 201}$ + (Total Load)$_{Subwatershed\ 202}$
              = 19,386 billion MPN/year + 1,732,709 billion MPN/year
              = 1,752,095 billion MPN/year

TMDL   = (Allowable Load)$_{Subwatershed\ 201}$ + (Allowable
                                              Load)$_{Subwatershed\ 202}$
              = 563 billion MPN/year + 83,999 billion MPN/year
              = 84,562 billion MPN/year

TMDL calculations in all watersheds using final numeric targets are lower than TMDLs calculated using interim numeric targets. Final TMDLs for all watersheds are shown in Table I-6.

Table I-6. Final Wet Weather TMDLs (Billion MPN/Year)

Watershed	Fecal Coliform TMDLs	Total Coliform TMDLs	Enterococci TMDLs
Laguna/San Joaquin	16,042	401,049	4,175
Aliso Creek	84,562	2,109,599	13,704
Dana Point	14,894	372,327	3,875
San Juan Creek	358,410	8,947,114	56,119
San Clemente	36,481	911,982	9,492
San Luis Rey River	641,823	16,030,005	174,221
San Marcos	1,559	38,984	406
San Dieguito River	431,004	10,801,713	133,530
Miramar	312	7,811	81
Scripps	10,329	258,228	2,686
San Diego River	311,132	7,761,345	48,356
Chollas Creek	55,516	1,386,037	9,073

2.Calculate Percent Reduction Required Per Discharge Category

Comparing the final wet weather TMDLs to the loads from the uncontrollable sources (from the previous analysis) show that, in every watershed except for San Marcos, the loads from uncontrollable sources are greater than the TMDL. This indicates that the natural bacteria sources in these watersheds consume and exceed the assimilative capacity of the receiving waters, resulting in allocations of zero loads to all remaining sources, namely controllable point and nonpoint sources. San Marcos is the only exception and was therefore calculated according to the procedures set forth in section 1.4, without the 22 percent exceedance frequency given to interim targets.

For Municipal MS4s, the percent reduction required for the Aliso Creek watershed is:

$$Percent\ Reduction = \frac{(649,935\ billion\ MPN/mL - 0\ MPN/mL)}{649,935\ billion\ MPN/mL}$$

Percent Reduction   = 1

             = 100%

Similarly, for agriculture, livestock, and horse ranch facilities in the San Juan watershed,

$$Percent\ Reduction = \frac{(3{,}275{,}225\ billion\ MPN/mL - 0\ MPN/mL)}{3{,}275{,}225\ billion\ MPN/mL}$$

Percent Reduction   = 1

             = 100%

In order to meet the final numeric targets, the required reduction for each indicator bacteria from all controllable sources in all watersheds is 100 percent.

Table I-7 shows the WLAs, LAs, and percent reductions using final numeric targets for the Aliso and San Juan watersheds using the methods outlined in this appendix. This information is available for the remaining watersheds and is reported in Tables 9-2, 9-5, and 9-9 in section 9 of the Technical Report.

Table I-7. Final Wet Weather WLAs and LAs (Billion MPN/Year) for Fecal Coliform in the Aliso Creek and San Juan Creek Watersheds

Watershed	TMDL	WLA (Municipal MS4)	% Reduction	WLA (Caltrans)	% Reduction	LA (Ag/Livestock)	% Reduction	LA (Open Space)*
Aliso Creek	84,562	0	100	0	100	0	100	1,075,085
San Juan Creek	358,410	0	100	0	100	0	100	10,701,109

* No bacteria load reductions are required from Open Space category because allocations are equal to existing loads.

I.6I.5 Calculation of Dry Weather TMDLs and AllocationsUsing Interim and Final Numeric Targets for Dry Weather Analysis

Because the density of bacteria in receiving waters during dry weather is extremely variable in nature, a separate approach from the wet weather LSPC model was needed. An approach was developed that relied on detailed analysis of available data to better identify and characterize sources.

To represent the linkage between source contributions and in-stream response, a steady-state mass balance model was developed to simulate transport of bacteria in the impaired creeks and the creeks flowing to impaired shorelines. This predictive model represents the streams as a series of plug-flow reactors, with each reactor having a constant, steady state flow and bacteria load. The development of the dry weather model is described in Appendix K.

The methodology for calculating and allocating the dry weather TMDLs for each watershed is described in the following steps:For the dry weather model, final numeric targets were used to calculate TMDLs, although in a different capacity than interim and final numeric targets for wet

weather TMDLs. Step 1 shows how numeric targets were used, and step 2 shows how TMDLs were allocated.

    Step 1.   Calculate Dry Weather Existing Loads and TMDLs;
    Step 2.   Distribute TMDL Among Four Discharge/Land Use Categories.

Descriptions of each step are provide below.

1.   Use of Final Numeric TargetsCalculate Dry Weather Existing Loads and TMDLs
Unlike the wet weather modeling approach, the numeric targets used in the dry weather modeling approach does not include the use of the reference system approachhave a zero percent allowable exceedance frequency. This is because available data show that exceedances of WQOs in local reference systems during dry weather conditions are uncommon (see Technical Report, section 4.2). Furthermore, reference systems do not generate significant dry weather bacteria loads because flows are minimal. During dry weather, flow, and hence bacteria loads, are largely generated by urban runoff, which is not a product of a reference system. Thus, the dry weather TMDL calculations are based entirely on meeting the geometric mean REC-1 WQOs. Therefore interim numeric targets for dry weather to incorporate a reference system are unnecessary.

Final numeric targets were utilized in a different capacity from the wet weather analysis. Final numeric targets were utilized for total coliform, for protection of the REC-1 beneficial uses. Final aA steady-state plug-flow reactor model was used to calculate dry weather existing loads and allowable loads. Total existing bacteria loads were calculated using the plug-flow reactor model predicted flow multiplied by the land-use-specific bacteria densities derived from regression analyses of bacteria water quality data from several regional watersheds. Allowable dry weather bacteria loads, were calculated using the REC-1 WQOs as numeric targets. To calculate theor TMDLs, were calculated using the dry weather plug-flow reactor model predicted flow was multiplied by the applicable numeric target, which is the geometric mean REC-1 WQO (see section 4 of the Technical Report). Tables I-108 shows the final dry weather existing loads and TMDLs calculated for all watersheds.

Table I-108. Final Dry Weather TMDLs (Billion MPN/Month)

Watershed	Fecal Coliform		Total Coliform		Enterococci	
	Existing	TMDL	Existing	TMDL	Existing	TMDL
San Joaquin Hills HSA/Laguna Beach HSA	2,741	227	13,791	1,134	2,321	41
Aliso HSA	5,470	242	26,639	1,208	4,614	40
Dana Point HSA	1,851	92	9,315	462	1,567	16
Lower San Juan HSA	6,455	1,665	30,846	8,342	5,433	275
San Clemente HA	3,327	192	16,743	958	2,817	33
San Luis Rey HU	1,737	1,058	8,549	5,289	1,466	185
San Marcos HA	149	26	751	129	126	5
San Dieguito HU	1,631	1,293	7,555	6,468	1,368	226
Miramar Reservoir HA	205	7	1,030	36	173	1
Scripps HA	3,320	119	16,707	594	2,811	21
Tecolote HA	4,329	234	21,349	1,171	3,657	39
Mission San Diego HSA/Santee HSA	4,928	1,506	28,988	7,529	4,106	248
Chollas HSA	5,068	398	25,080	1,991	4,283	66

1.2.TMDL Allocation

Unlike wet weather loading, which is caused by rain events, dry weather analysis showed that dry weather loading is dominated by nuisance flows from urban land use activities such as car washing, sidewalk washing, and lawn over-irrigation, which pick up and transport bacteria the the municipal MS4s into receiving waters. These types of nuisance flows are referred to as urban runoff. Urban runoff is non-storm water runoff.

Because urban runoff is overwhelmingly the main source of bacteria loading during dry weather, the TMDLs calculated from the mass balance model were allocated solely to Municipal MS4s. Allocations for nonpoint sources were unnecessary since land uses associated with these sources generally do not generate runoff to receiving water during dry weather conditions. Additionally, dry weather loads from Caltrans highways were assumed to be insignificant because during dry periods there is no significant urban runoff from Caltrans owned roadway surfaces. Because nonpoint sources and Caltrans are not expected to generate runoff during dry weather conditions, the dry weather TMDLs were distributed as follows:

$$TMDL = WLA(Municipal\,MS4s) + WLA(Caltrans) + LA(Ag\,/\,Livestock) + LA(Open\,Space)$$

where $TMDL$ = Total Maximum Daily Load for entire watershed
        WLA (Municipal MS4s) =   Point source wasteload allocation for owners/operators of
                            Municipal MS4s
        WLA (Caltrans)   = 0 = No point source wasteload allocation for Caltrans
                            because no runoff expected
        LA (Ag/Livestock)   = 0 = No nonpoint source load allocation for
                            owners/operators of agriculture, livestock, and horse
                            ranch facilities/land uses because no runoff expected
        LA (Open Space)   = 0 = No nonpoint source load allocation for uncontrollable
                            sources of bacteria for open space, open recreation,
                            and water land uses because no runoff expected

In other words, dry weather discharges from any sources other than Municipal MS4s is not expected or allowed. Therefore, the dry weather TMDL is as follows:

$$TMDL = WLA(Municipal\,MS4s)$$

In other words, dry weather discharges from any sources other than Municipal MS4s is prohibited. Dry weather TMDLs are expressed on a monthly basis (MPN/month) because the numeric targets are equal to the 30-day geometric mean WQOs, and the dry weather model simulates average flows.

An example showing the total coliform TMDL allocation is shown using the Aliso Creek watershed as an example. For the Aliso Creek watershed, the existing total coliform load estimated by the model was approximately 26,639 billion MPN/month. The percent reduction required and the allocations are shown for the final period in Tables I-110.

*Table I-11θ. Dry Weather Final WLAs and LAs (Billion MPN/Month) for
Total Coliform in the Aliso Creek Watershed*

Watershed	TMDL	Point Sources				Nonpoint Sources			
		MS4		Caltrans		Ag/Livestock		Open Space	
		WLA	Reduction Required	WLA	Reduction Required	LA	Reduction Required	LA	Reduction Required
Aliso HSA	1,208	1,208	95.9%	0	0.00%	0	0.00%	0	0.00%

Watershed	TMDL	WLA (Municipal MS4s)	% Reduction	WLA (Caltrans)	LA (Ag/Livestock)	LA (Open Space)
Aliso Creek	1,208	1,208	95.9	0	0	0

Similar information for the remaining watersheds is reported in Tables 9-34a, 9-4b7 and 9-4c10 in section 9 of the Technical Report.

Figure I-5. Percent of Fecal Coliform Load Generated by Different Land Uses in the San Joaquin Hills HSA/Laguna Beach HSA Watershed

Figure I-6. Percent of Fecal Coliform Load Generated by Different Land Uses in the Aliso HSA Watershed

Figure I-7. Percent of Fecal Coliform Load Generated by Different Land Uses in the Dana Point HSA Watershed

Figure I-8. Percent of Fecal Coliform Load Generated by Different Land Uses in the Lower San Juan HSA Watershed

Figure I-9. Percent of Fecal Coliform Load Generated by Different Land Uses in the San Clemente HA Watershed

Figure I-10. Percent of Fecal Coliform Load Generated by Different Land Uses in the San Luis Rey HU Watershed

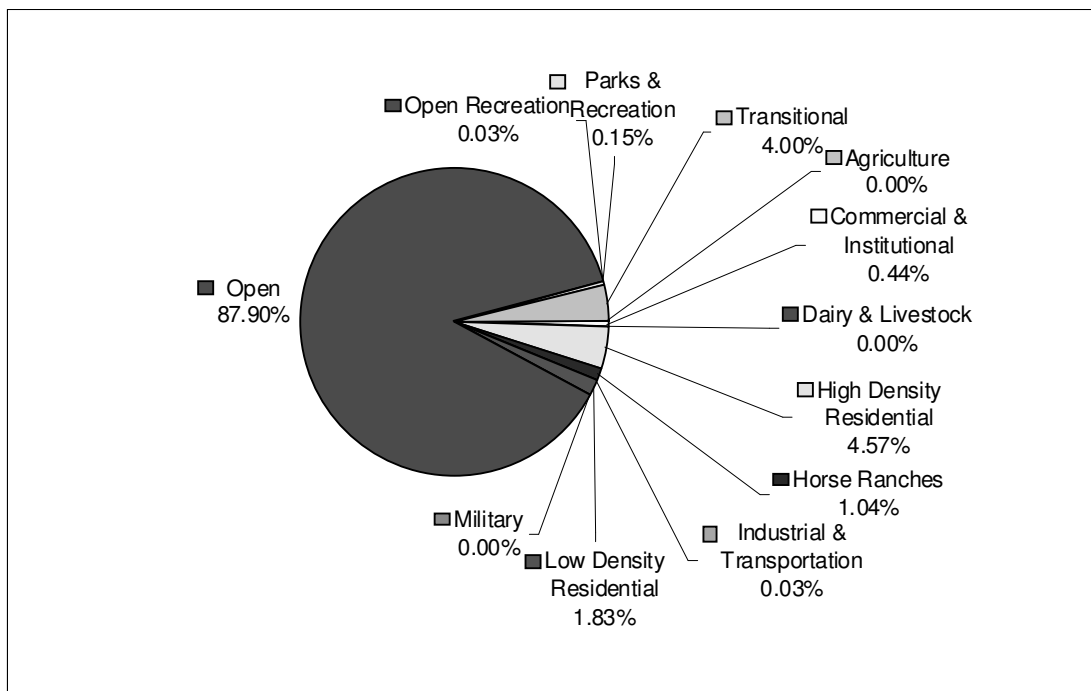*Figure I-11. Percent of Fecal Coliform Load Generated by Different Land Uses in the San Marcos HA Watershed*
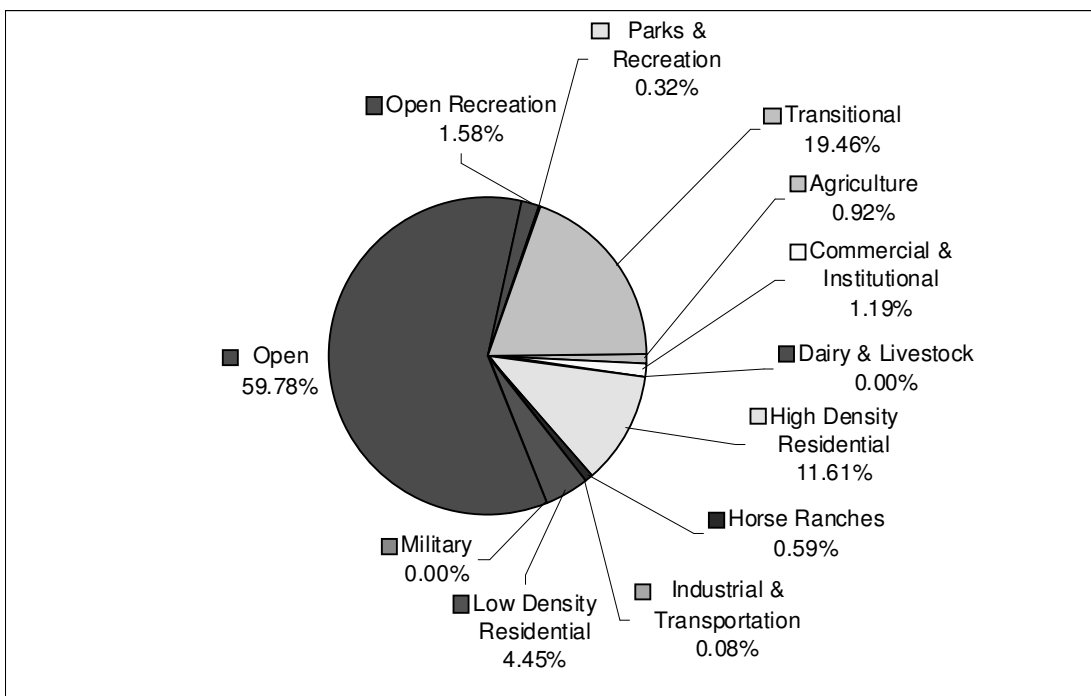

Figure I-12. Percent of Fecal Coliform Load Generated by Different Land Uses in the San Dieguito HU Watershed

Figure I-13. Percent of Fecal Coliform Load Generated by Different Land Uses in the Miramar Reservoir HA Watershed
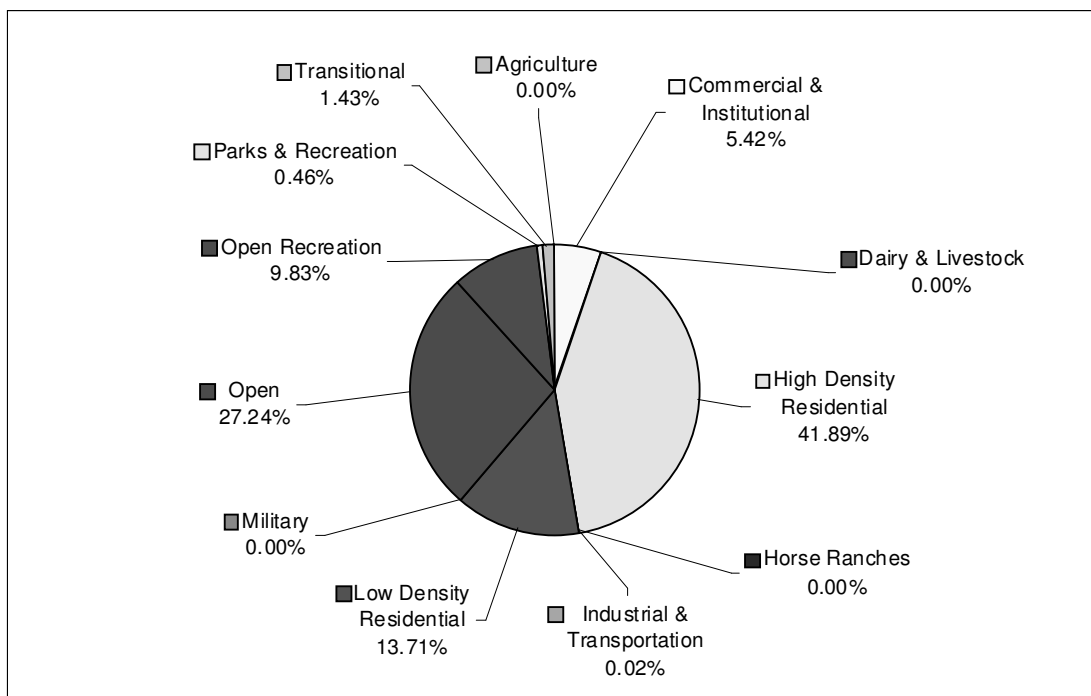
Figure I-14. Percent of Fecal Coliform Load Generated by Different Land Uses in the Scripps HA Watershed
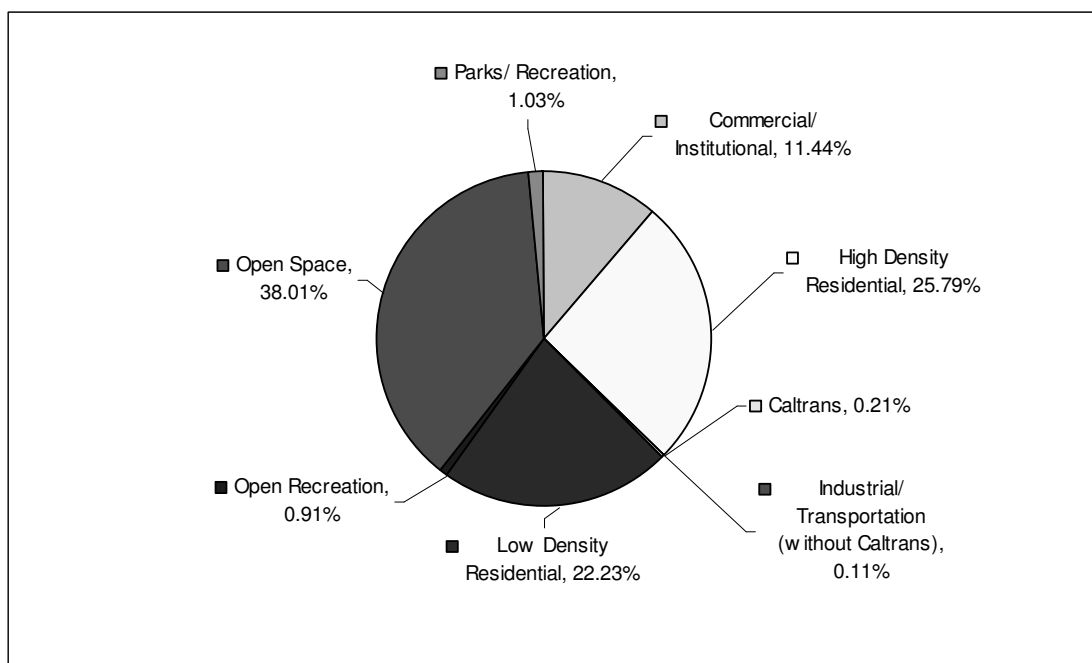
Figure I-15. Percent of Fecal Coliform Load Generated by Different Land Uses in the Tecolote HA Watershed
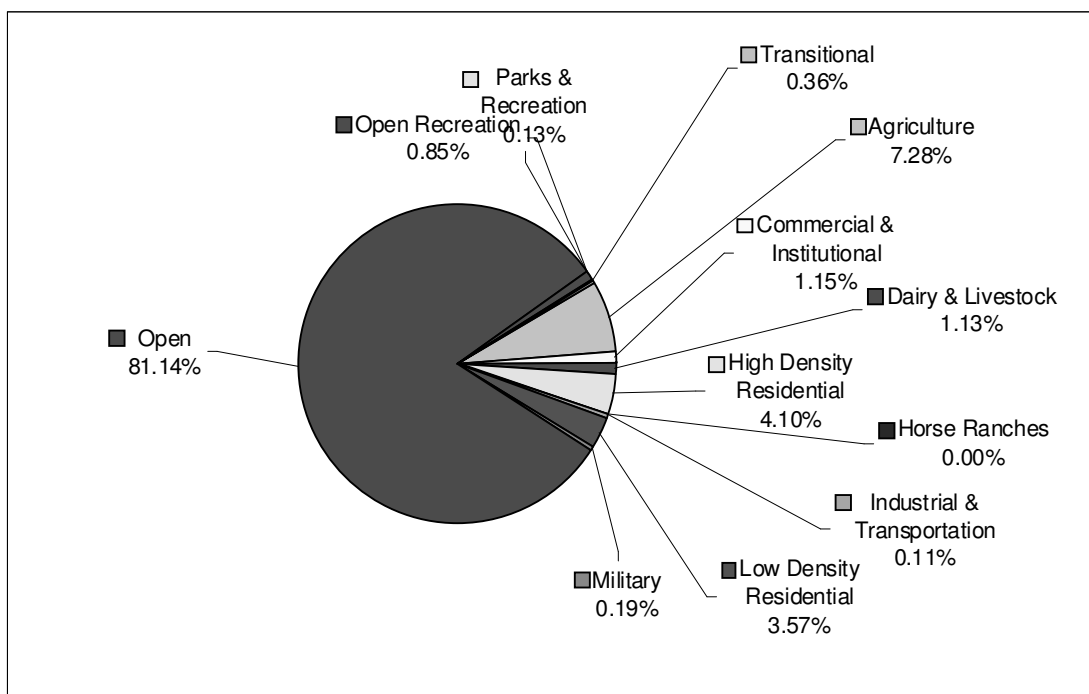
Figure I-165. Percent of Fecal Coliform Load Generated by Different Land Uses in the Mission San Diego HSA/Santee HSA River Watershed
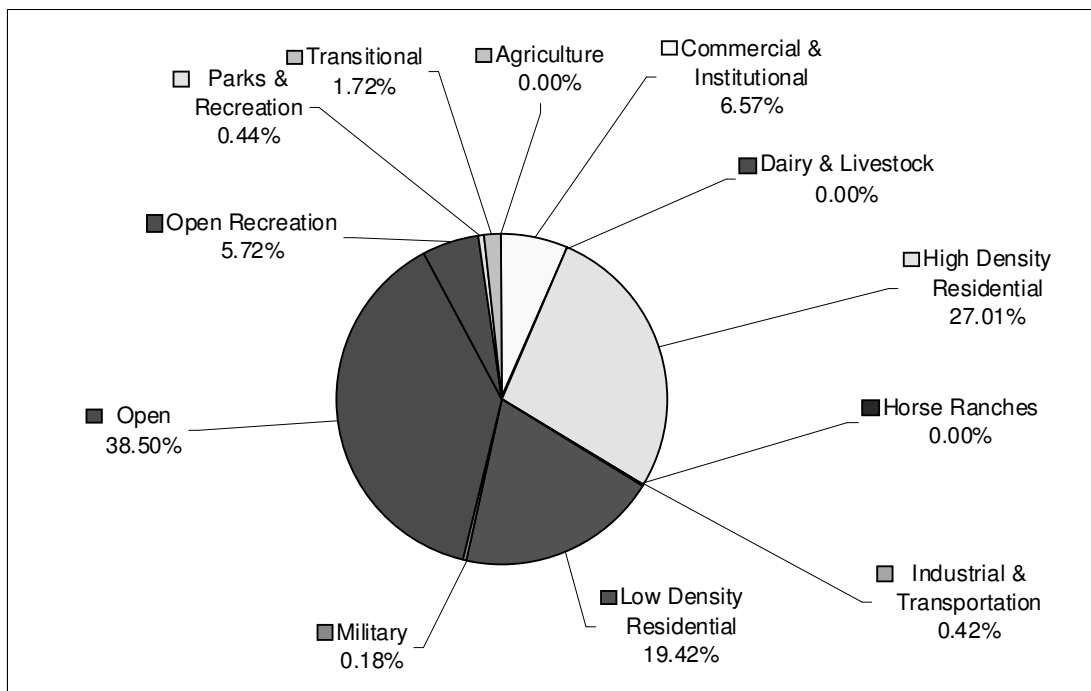
Figure I-176. Percent of Fecal Coliform Load Generated by Different Land Uses in the Chollas HSA Watershed
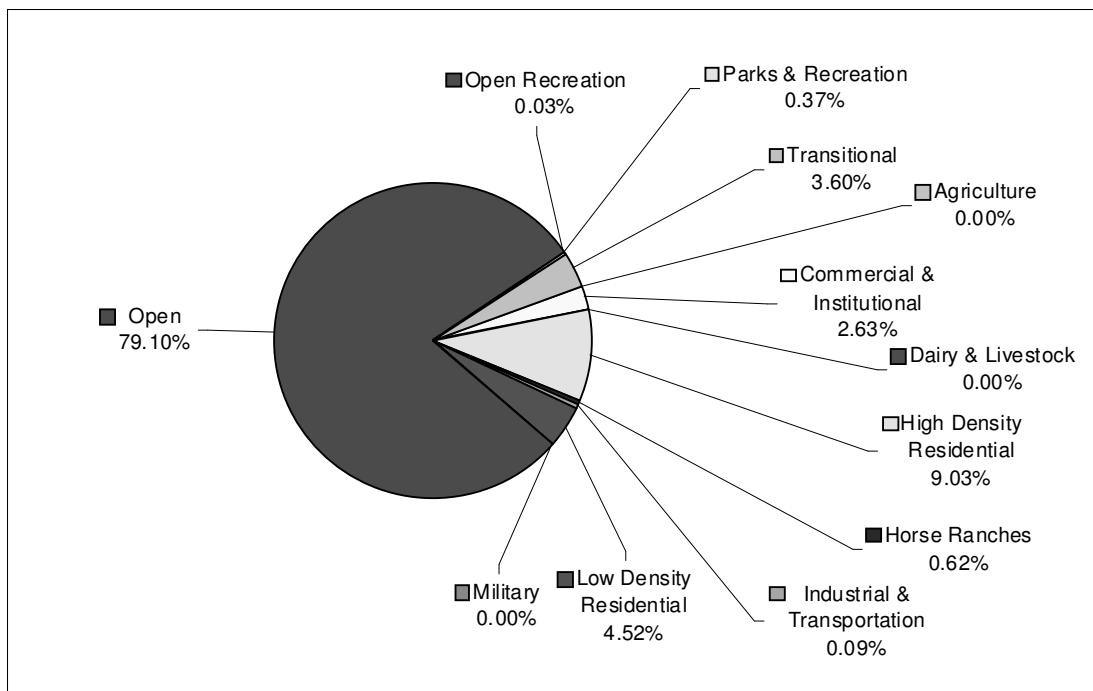
Figure I-187. Percent of Total Coliform Load Generated by Different Land Uses in the San Joaquin Hills HSA/Laguna Beach HSA Watershed
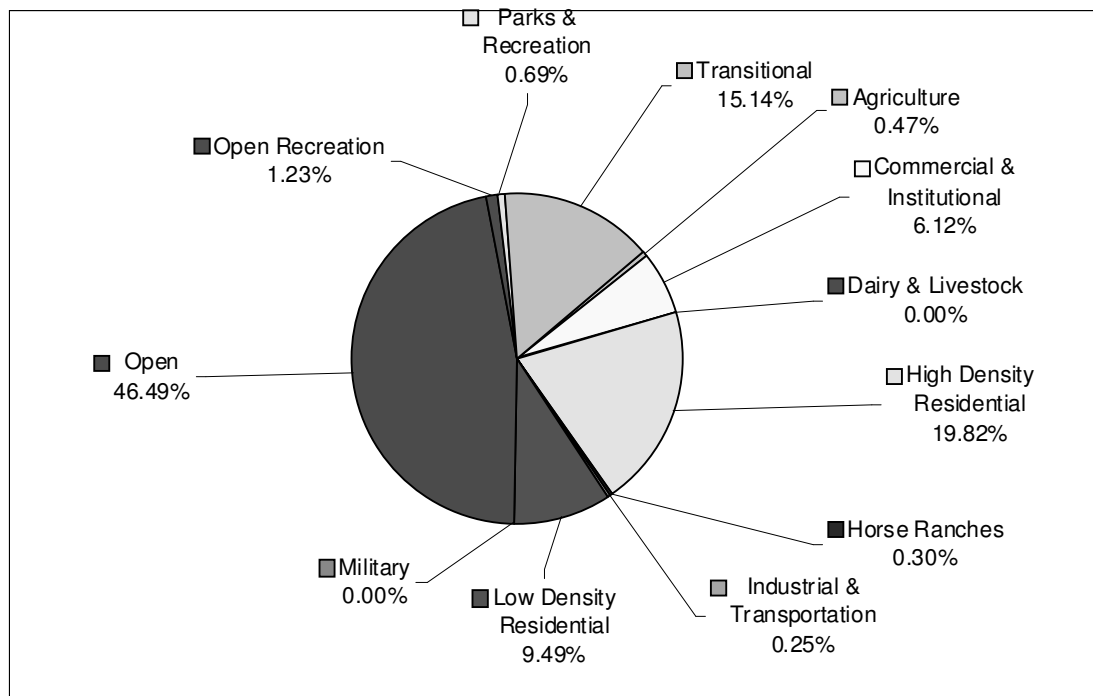
Figure I-198. Percent of Total Coliform Load Generated by Different Land Uses in the Aliso HSA Watershed
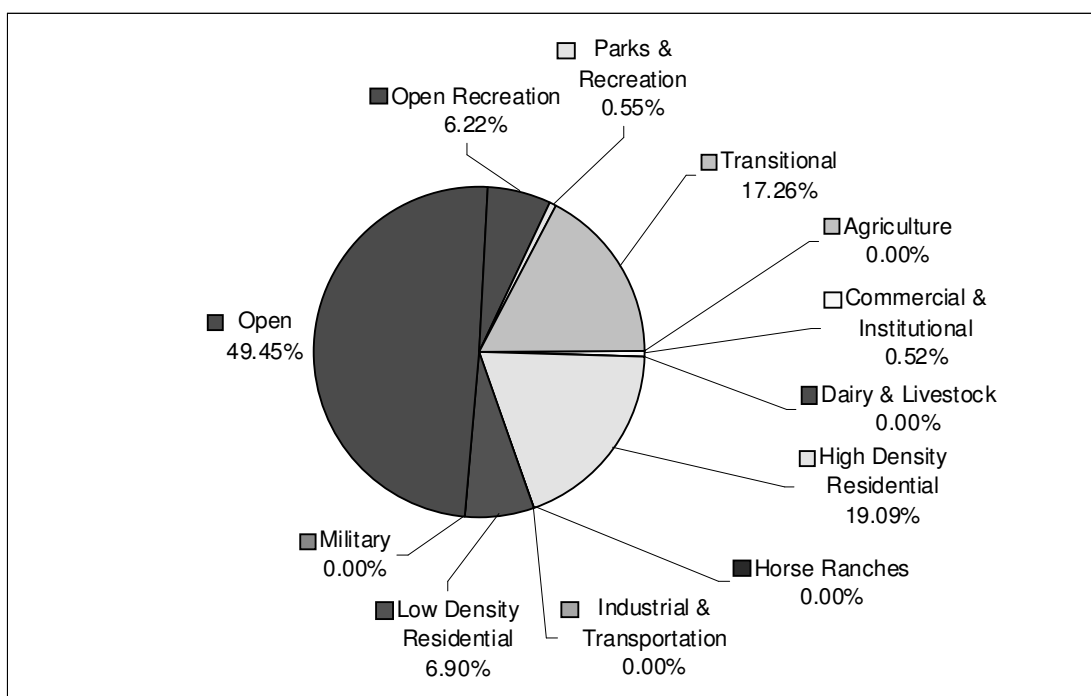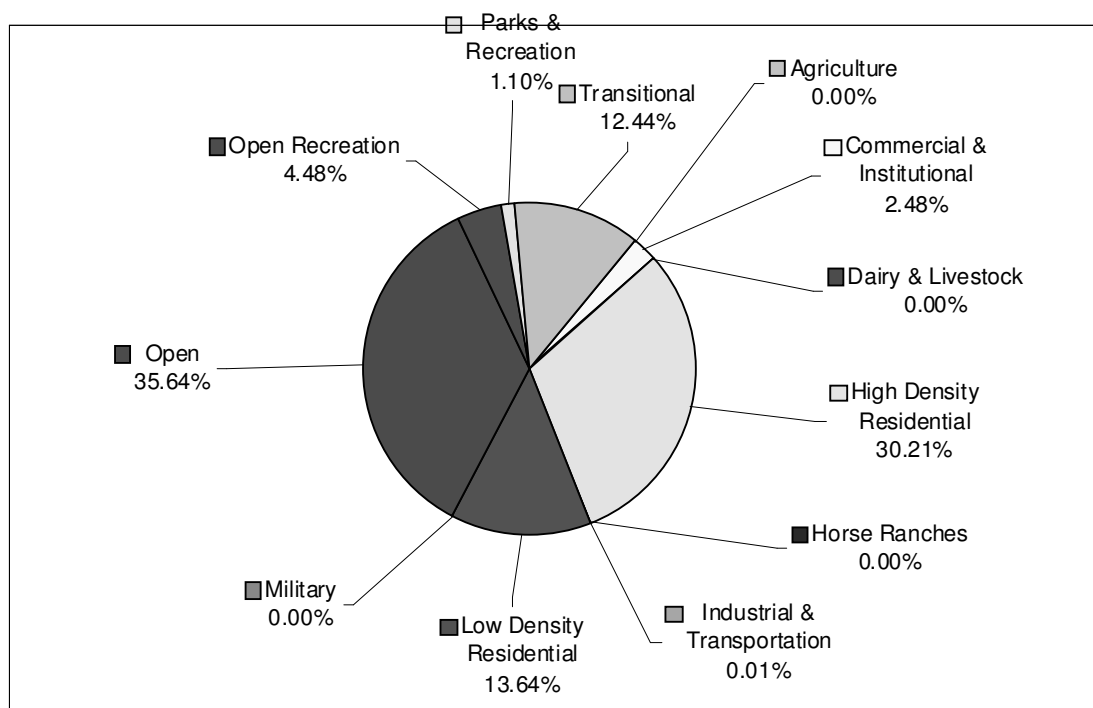
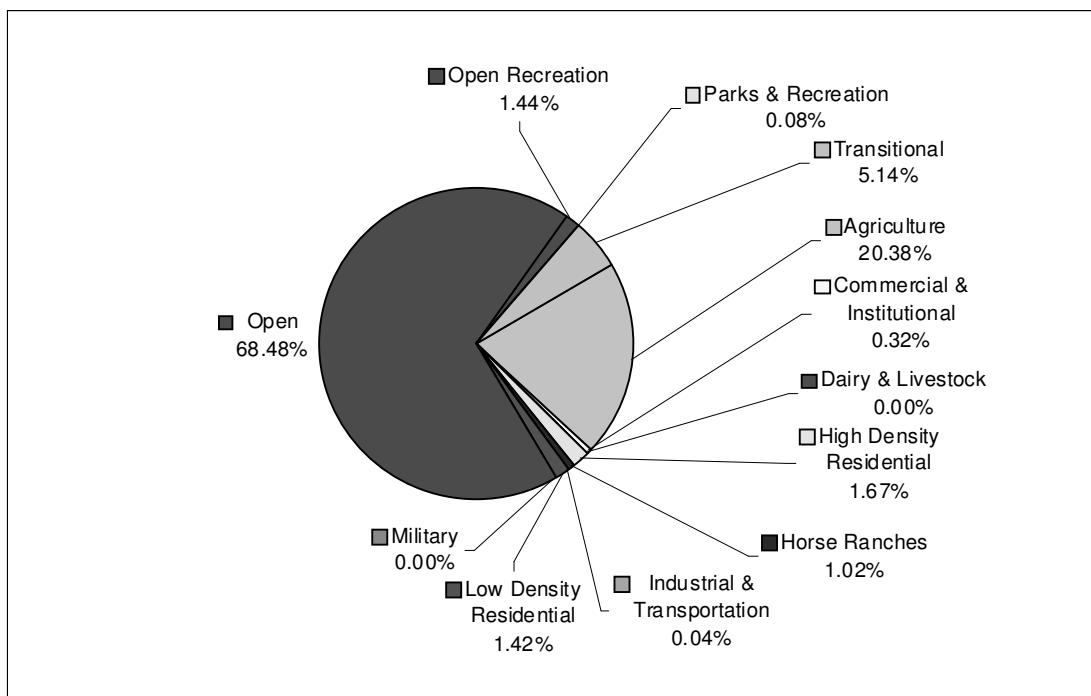*Figure I-2019. Percent of Total Coliform Load Generated by Different Land Uses in the Dana Point HSA Watershed*
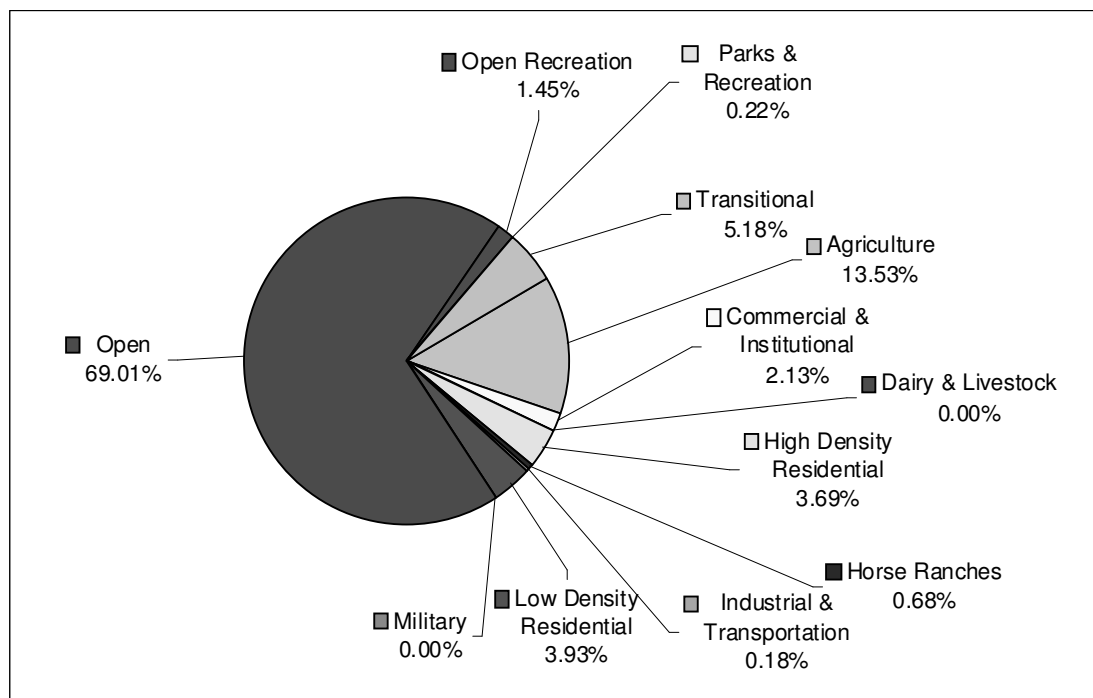
Figure I-210. Percent of Total Coliform Load Generated by Different Land Uses in the Lower San Juan HSA Watershed
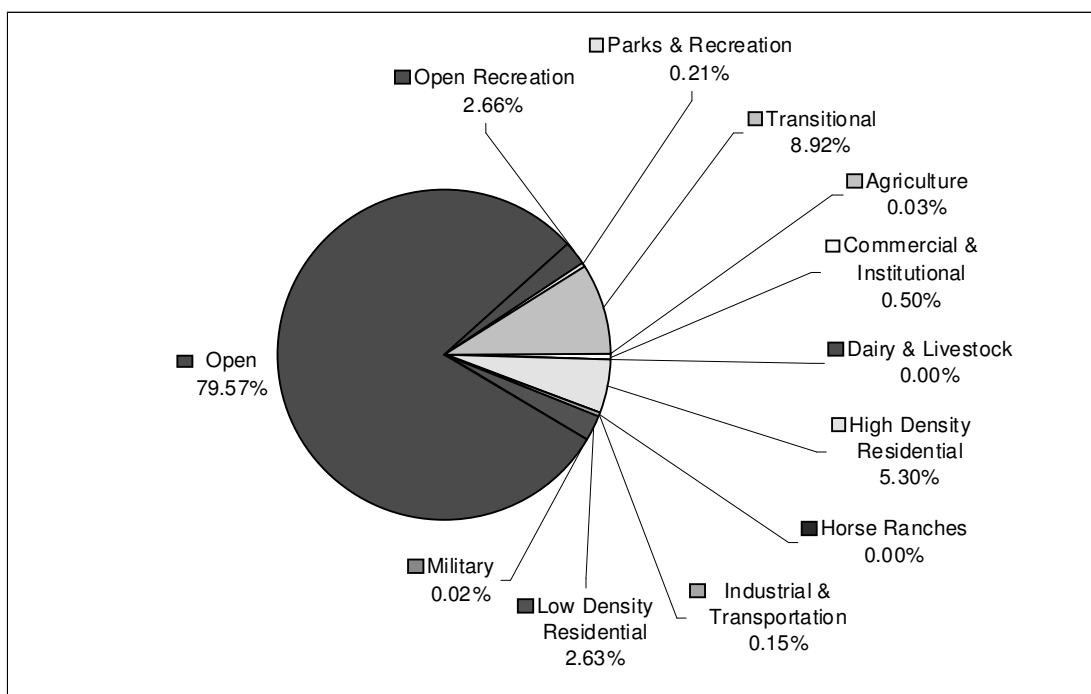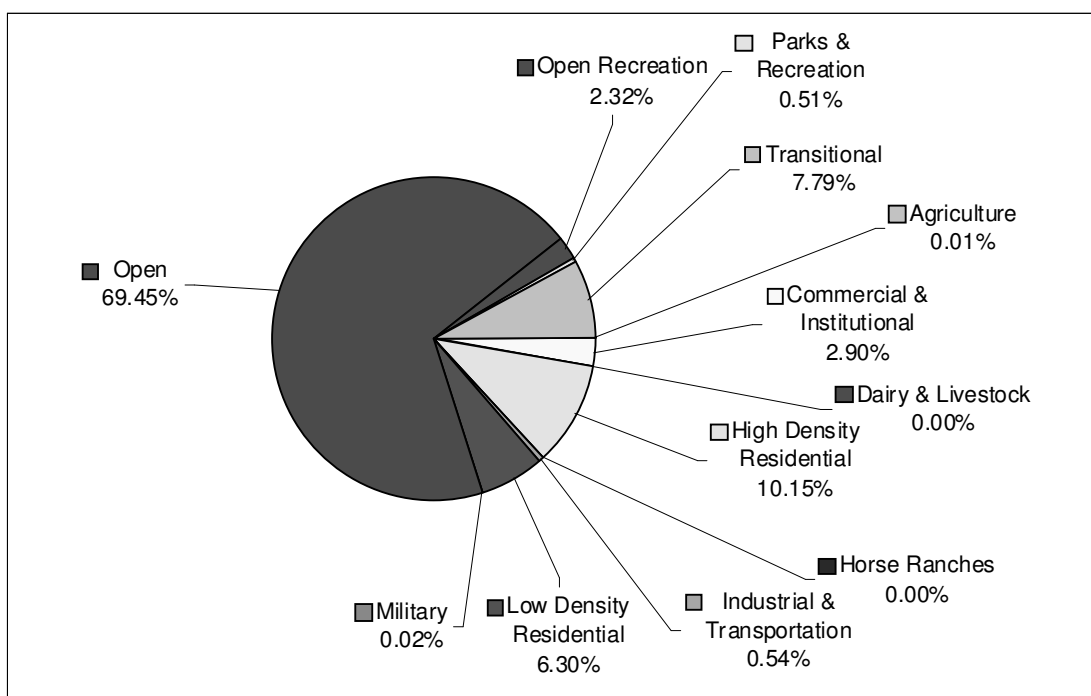
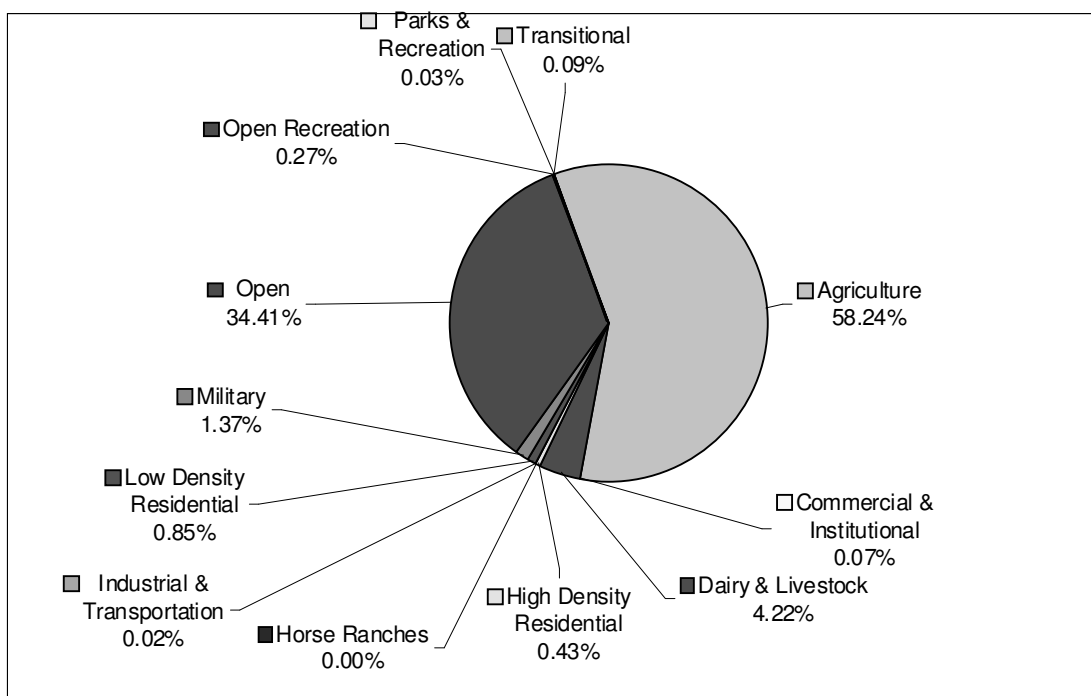*Figure I-22+. Percent of Total Coliform Load Generated by Different Land Uses in the San Clemente HA Watershed*
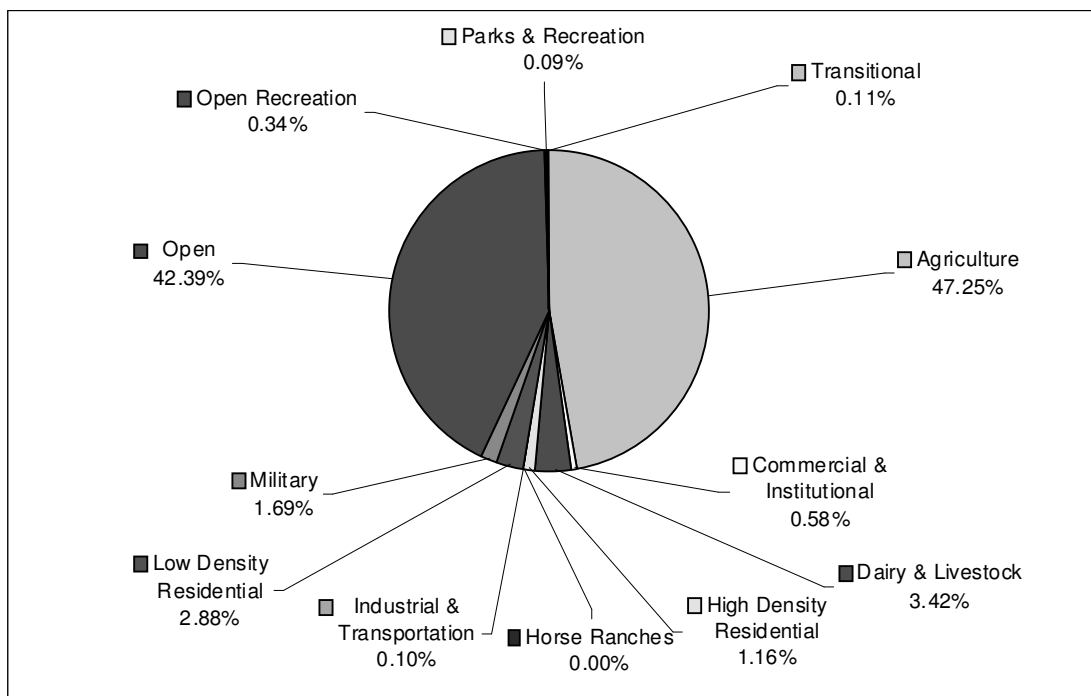
Figure I-232. Percent of Total Coliform Load Generated by Different Land Uses in the San Luis Rey HU Watershed
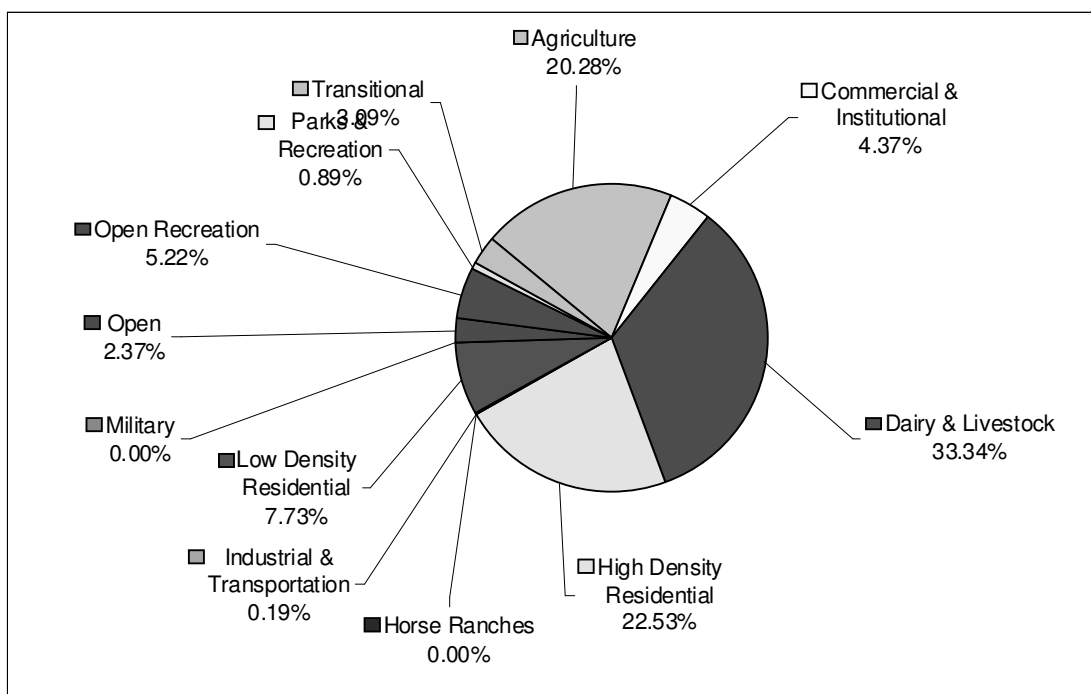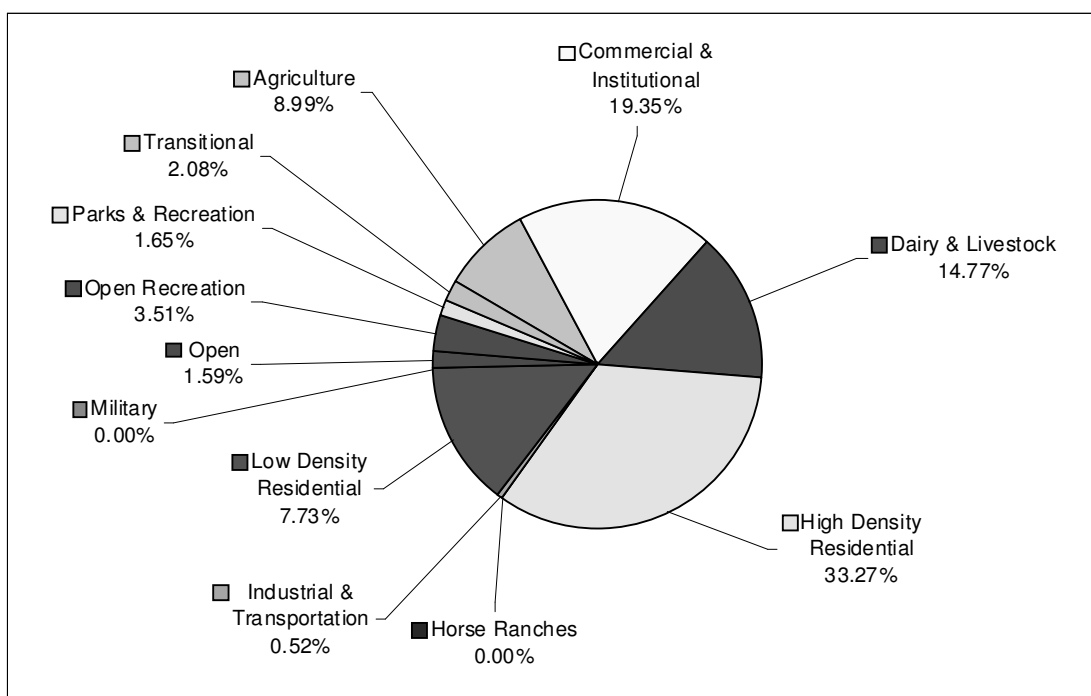
Figure I-243. Percent of Total Coliform Load Generated by Different Land Uses in the San Marcos HA Watershed
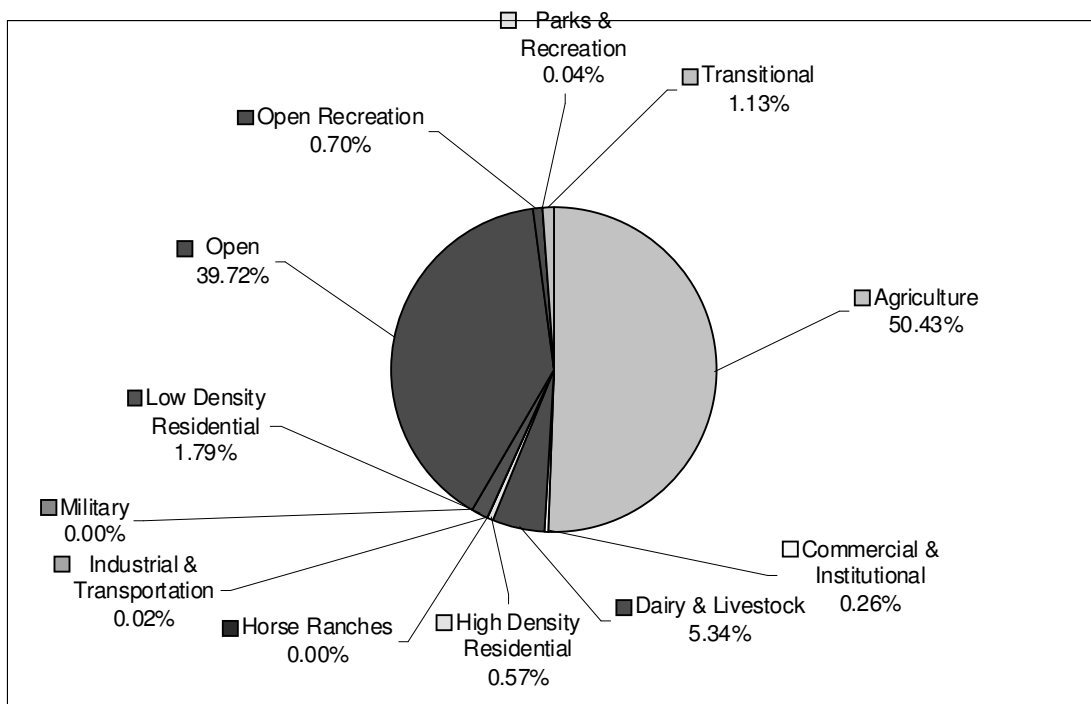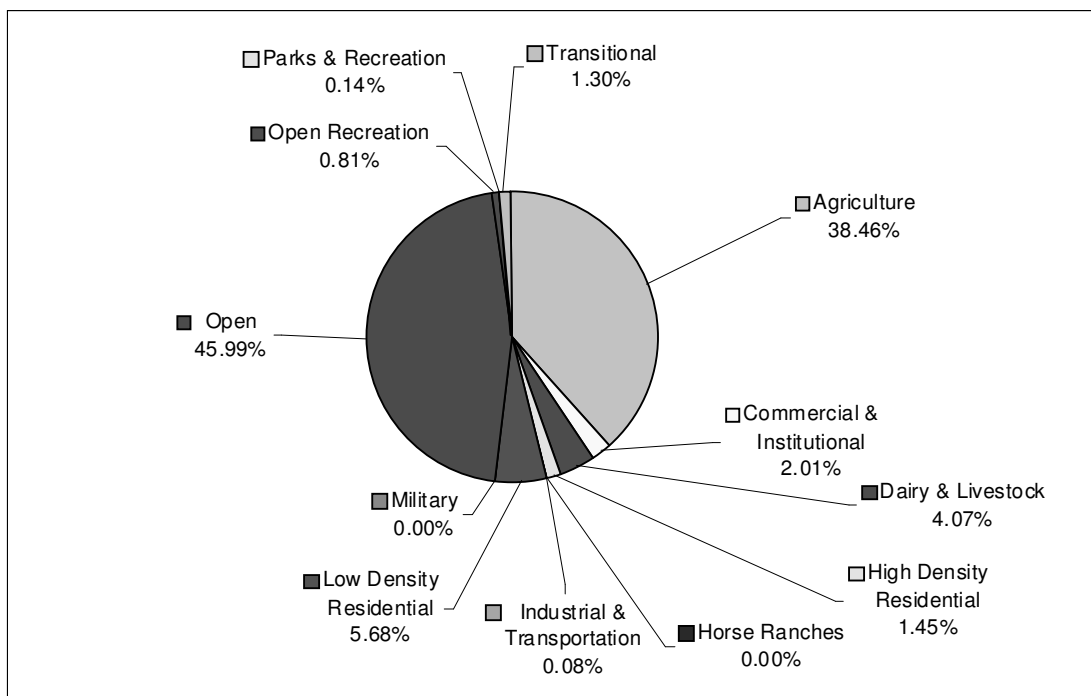

Figure I-254. Percent of Total Coliform Load Generated by Different Land Uses in the San Dieguito HU Watershed
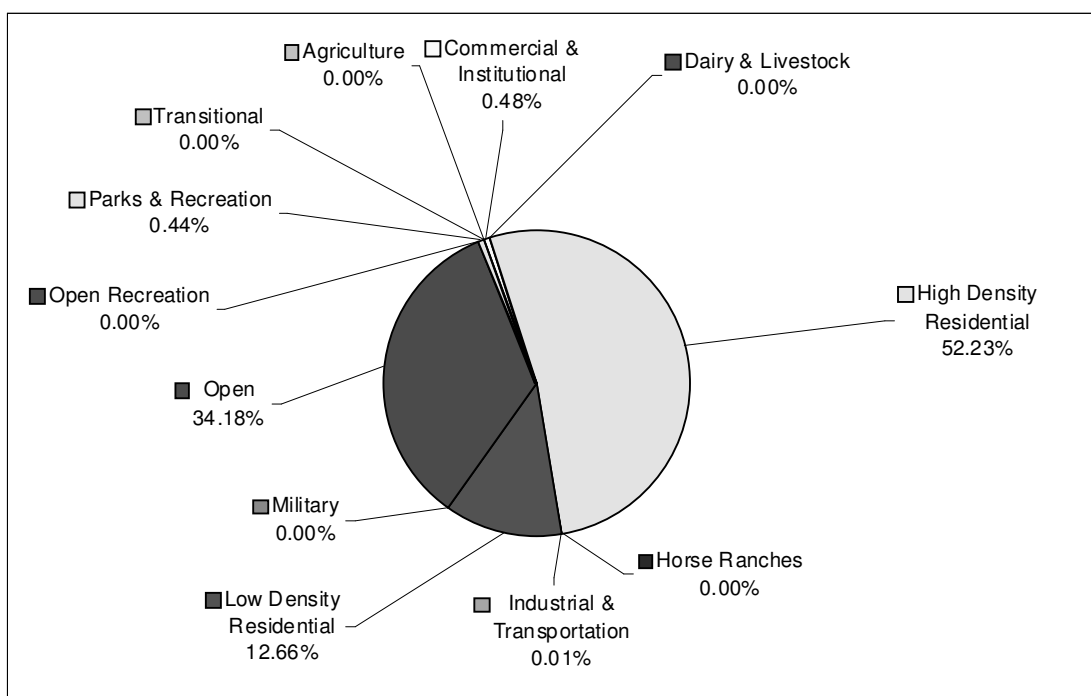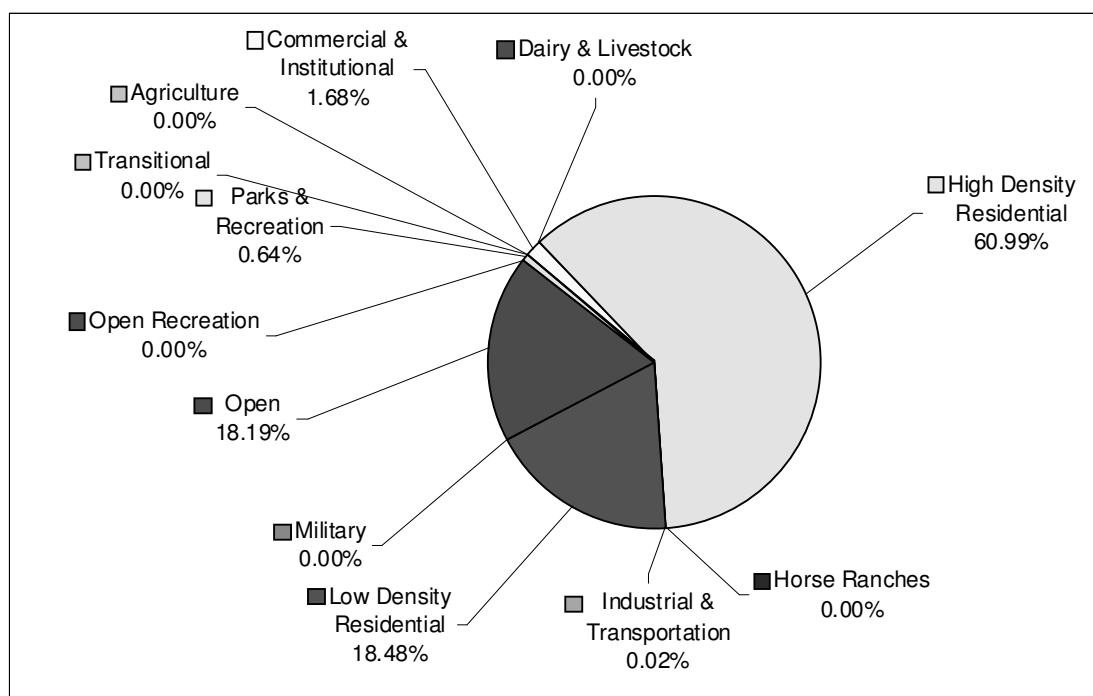
Figure I-265. Percent of Total Coliform Load Generated by Different Land Uses in the Miramar Reservoir HA Watershed
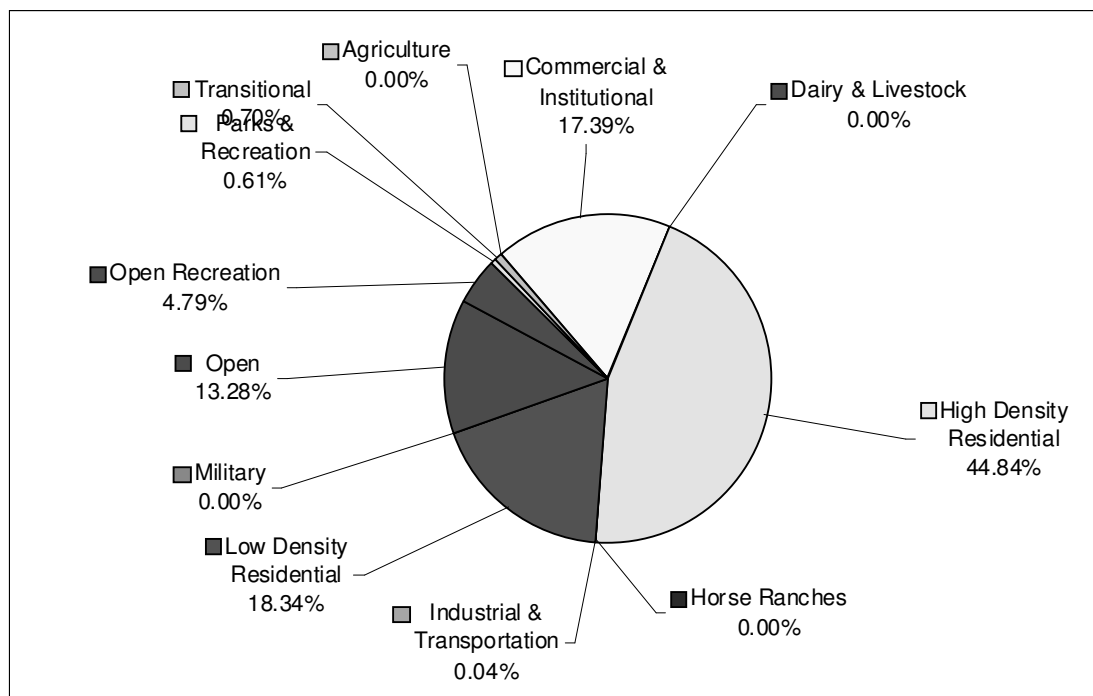
Figure I-276. Percent of Total Coliform Load Generated by Different Land Uses in the Scripps HA Watershed
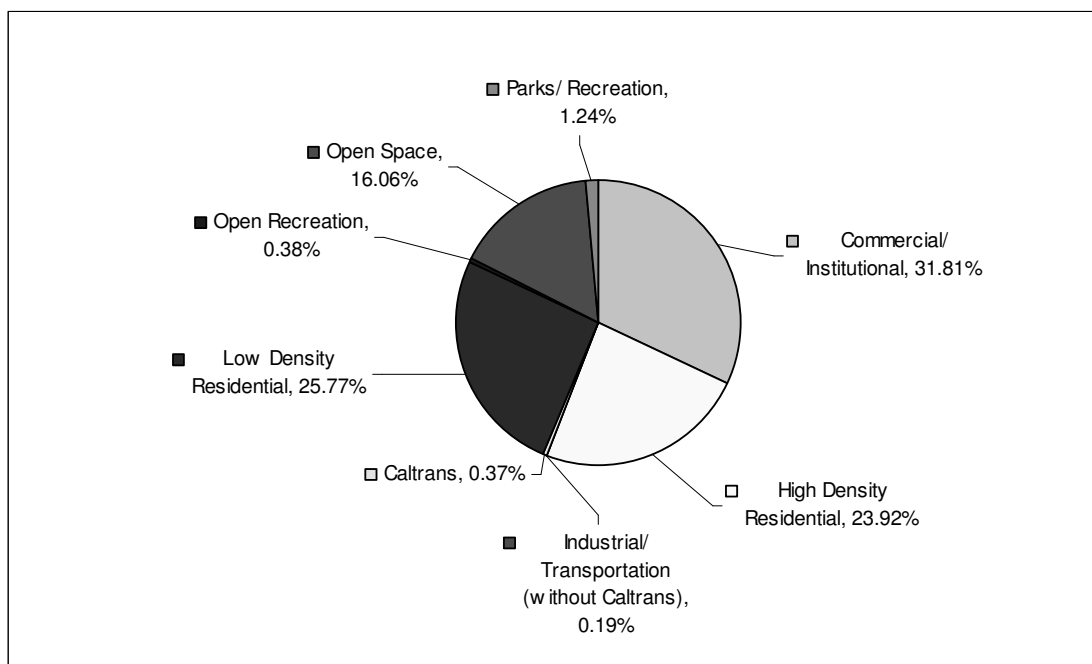
Figure I-28. Percent of Total Coliform Load Generated by Different Land Uses in the Tecolote HA Watershed
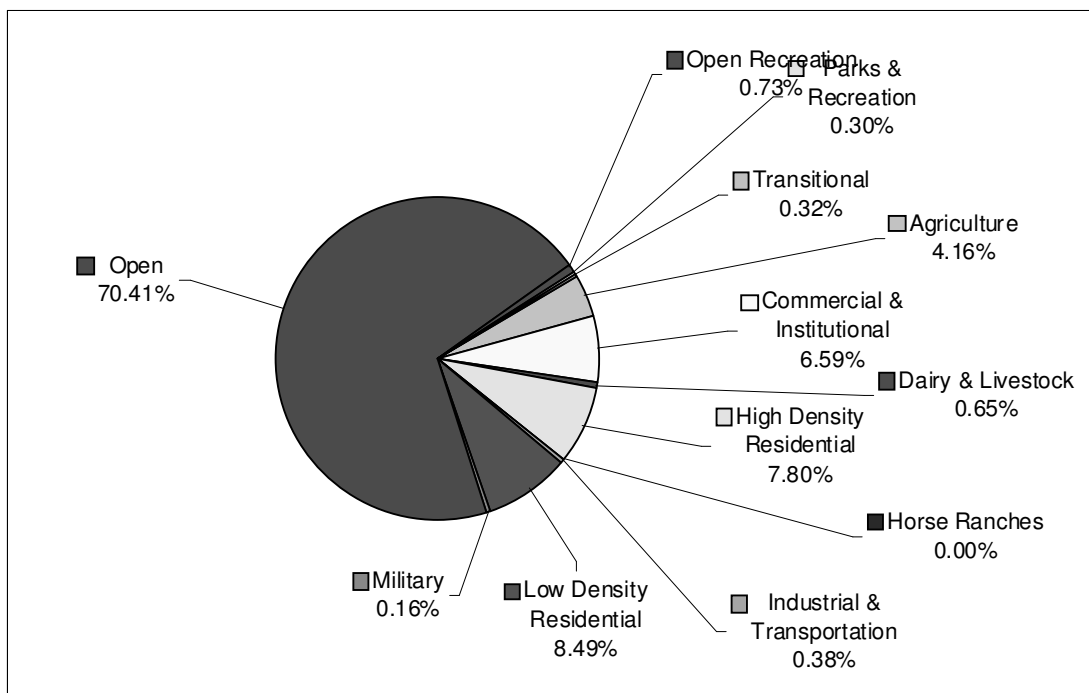
Figure I-297. Percent of Total Coliform Load Generated by Different Land Uses in the Mission San Diego HSA/ Santee HSA River Watershed
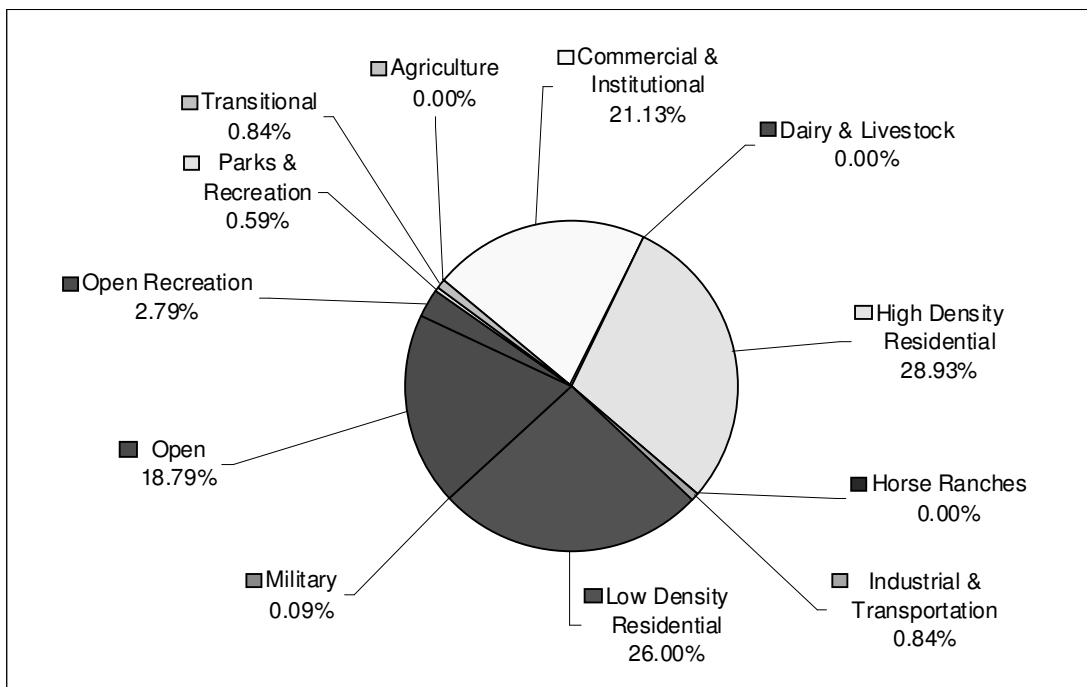
*Figure I-3028. Percent of Total Coliform Load Generated by Different Land Uses in the
Chollas HSA Watershed*
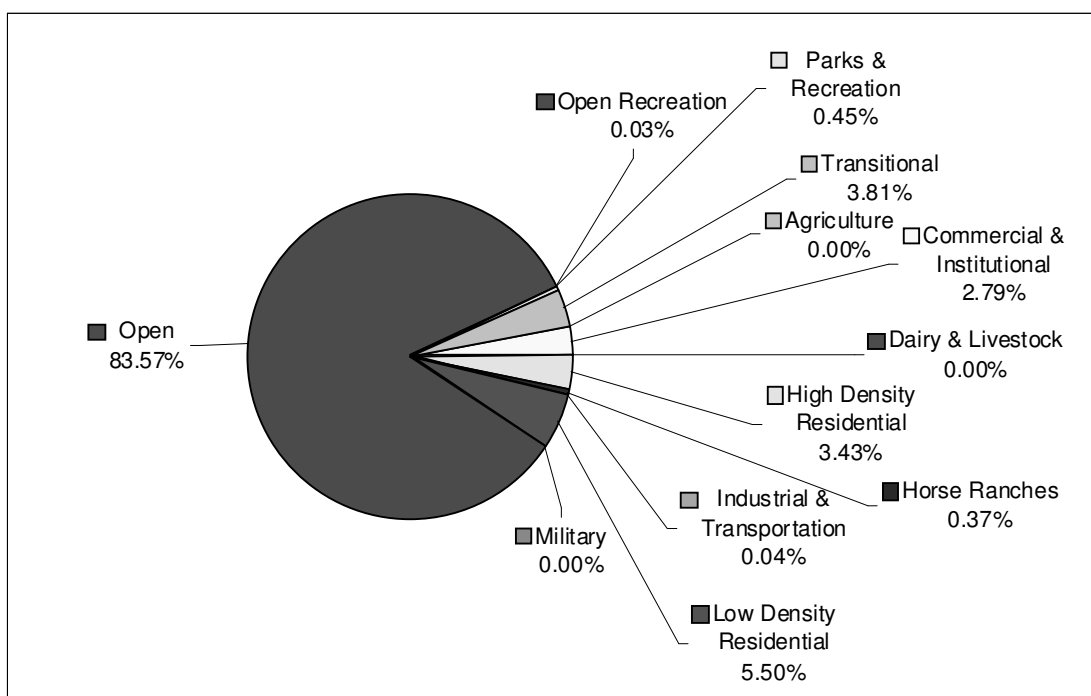
Figure I-3129. Percent of Enterococci Load Generated by Different Land Uses in the San Joaquin Hills HSA/Laguna Beach HSA Watershed
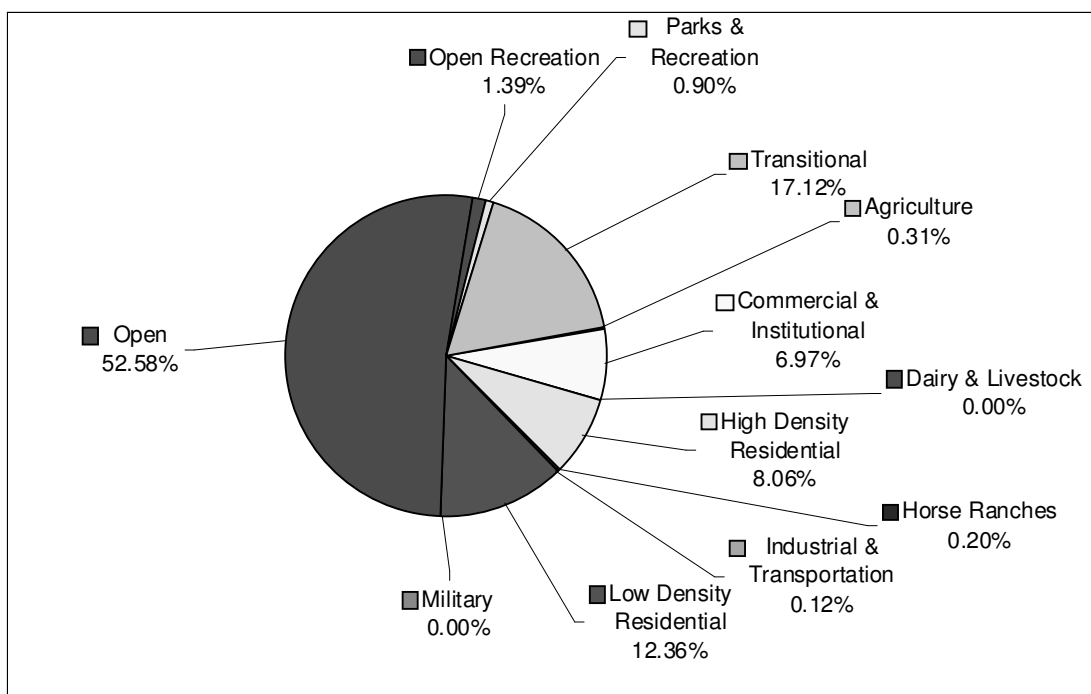
Figure I-320. Percent of Enterococci Load Generated by Different Land Uses in the Aliso HSA Watershed
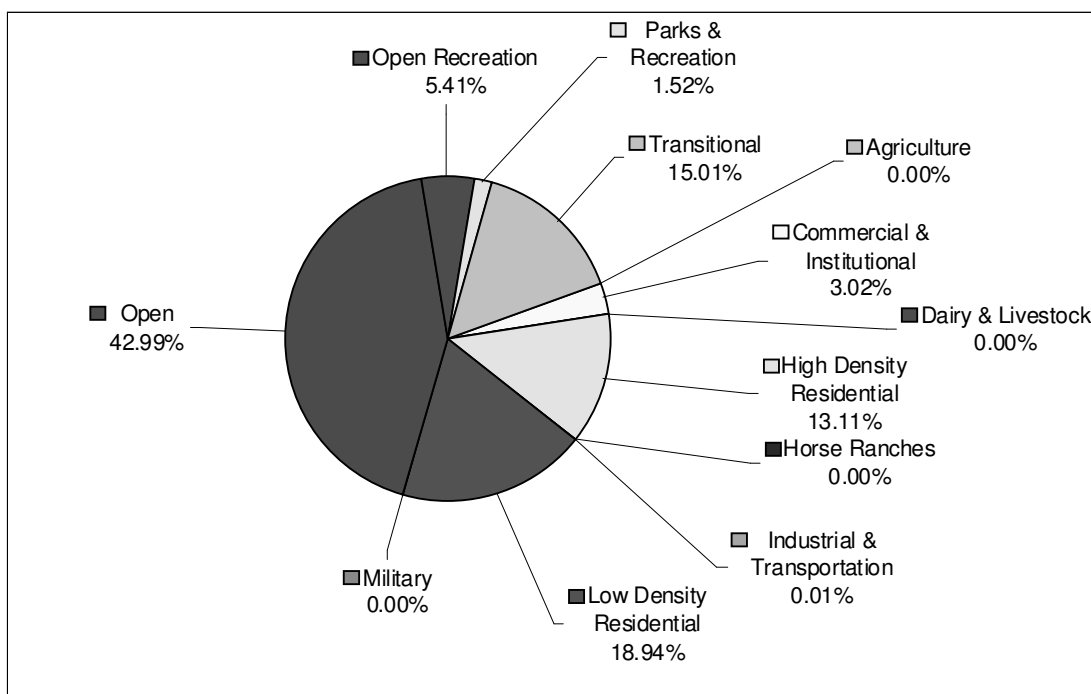
*Figure I-33+. Percent of Enterococci Load Generated by Different Land Uses in the
Dana Point HSA Watershed*
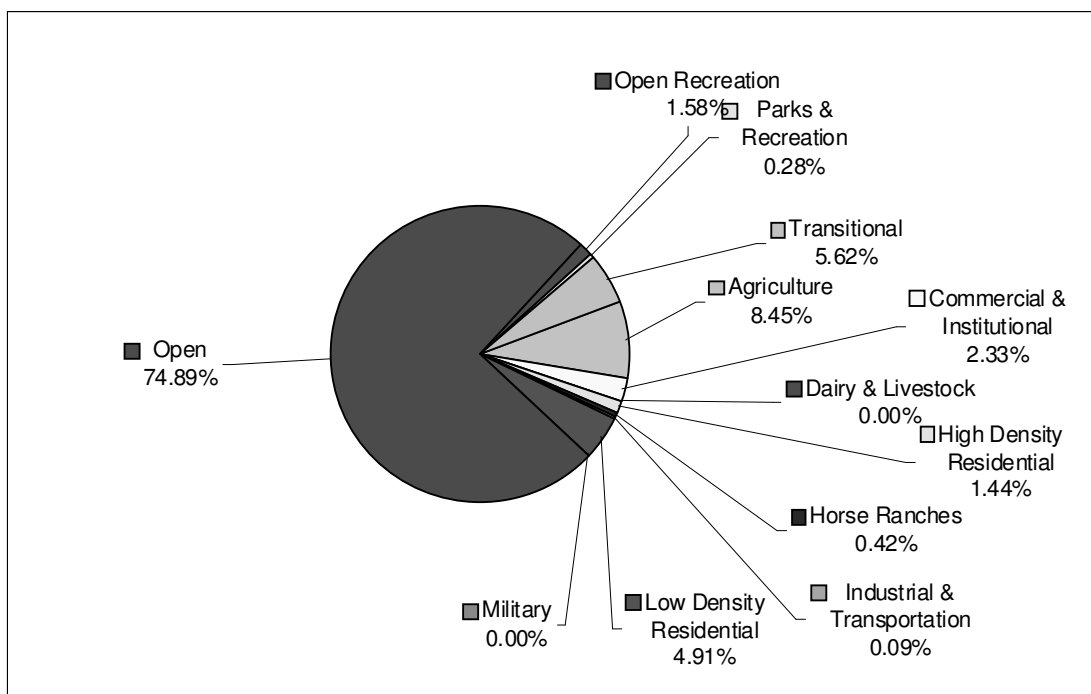
*Figure I-34₂. Percent of Enterococci Load Generated by Different Land Uses in the
Lower San Juan HSA Watershed*
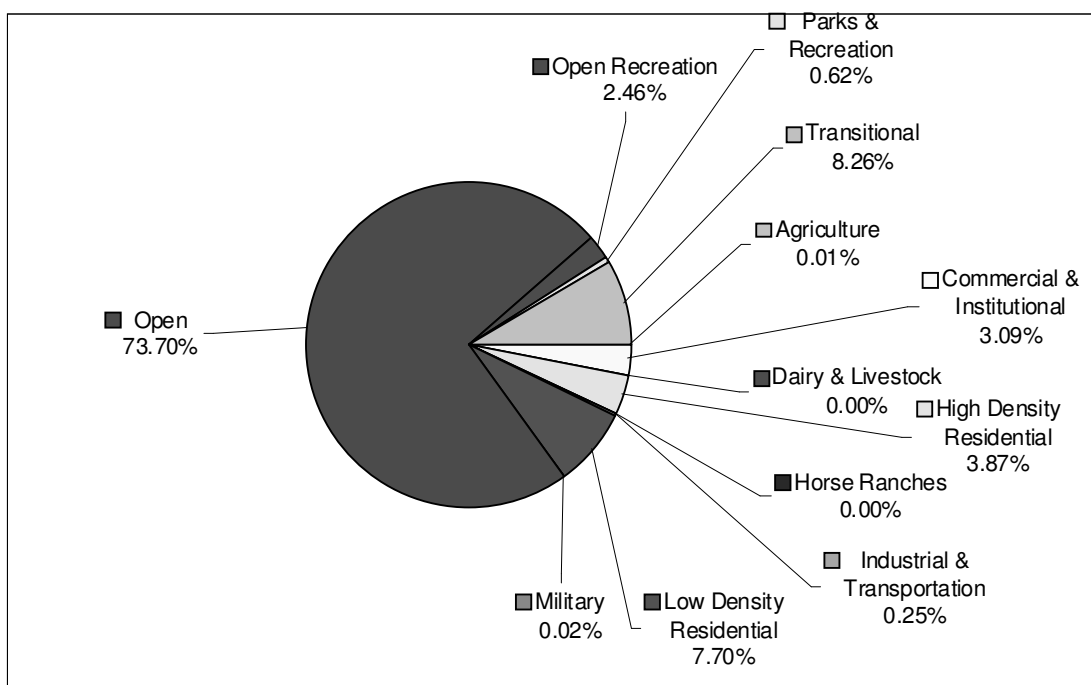
Figure I-3<u>5</u>~~3~~. Percent of Enterococci Load Generated by Different Land Uses in the San Clemente <u>HA</u> Watershed
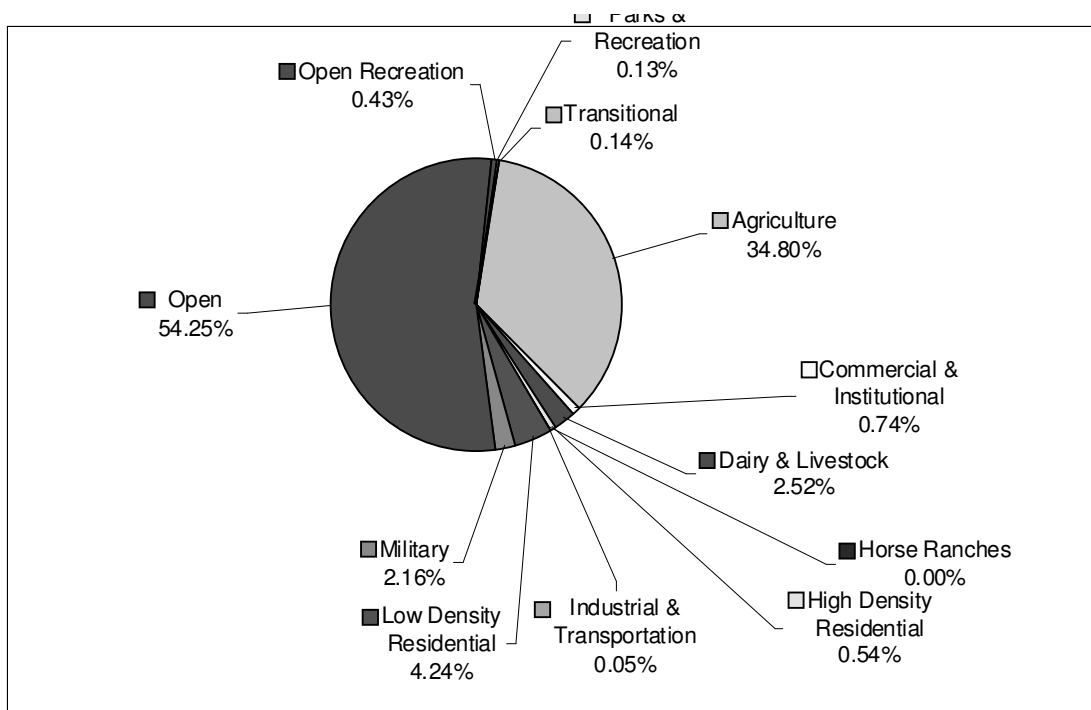
Figure I-3<u>6</u>~~4~~. Percent of Enterococci Load Generated by Different Land Uses in the San Luis Rey <u>HU</u> Watershed

I-45
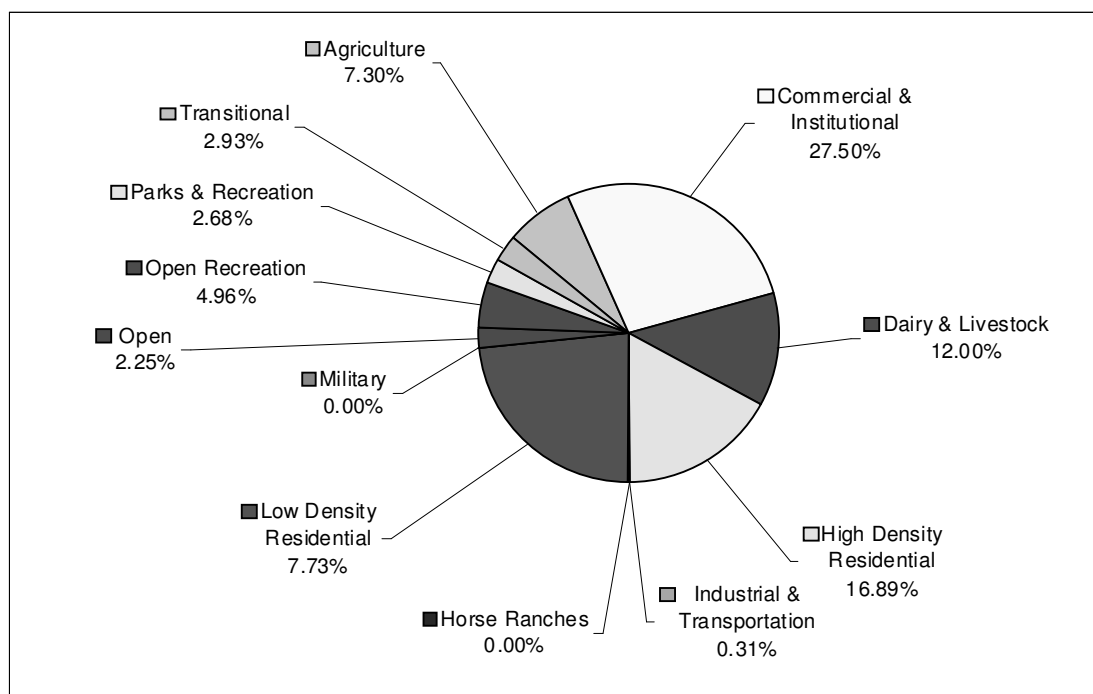
*Figure I-37₅. Percent of Enterococci Load Generated by Different Land Uses in the
San Marcos HA Watershed*
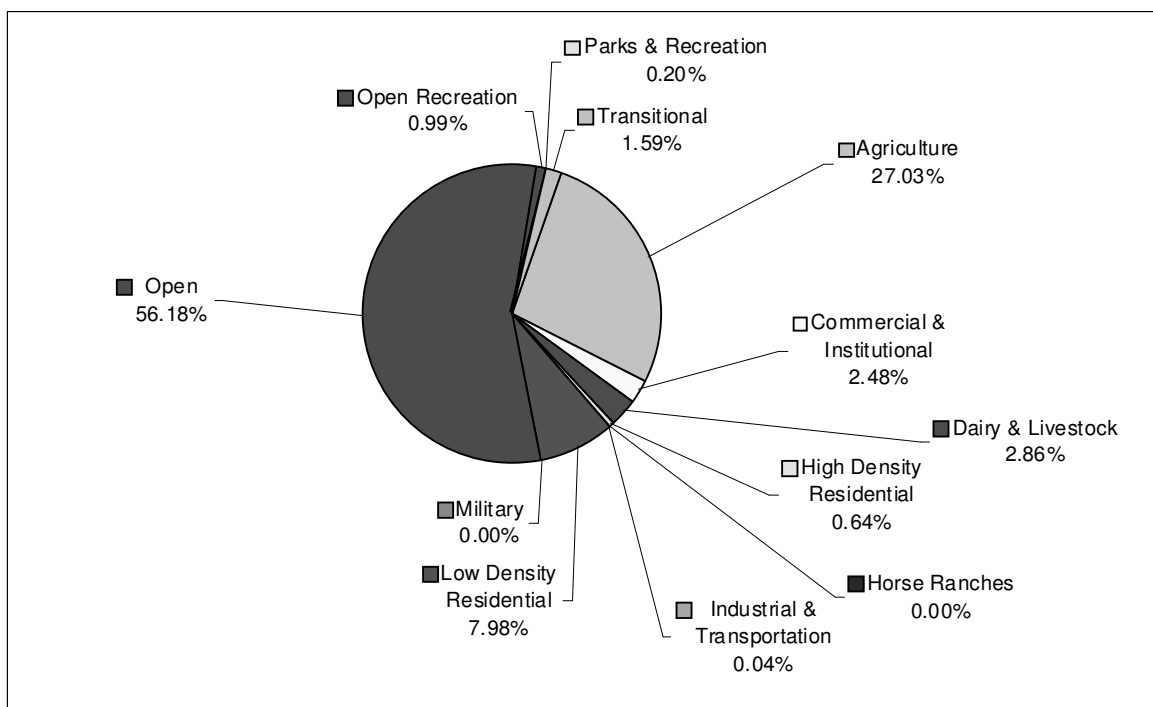
*Figure I-38₆. Percent of Enterococci Load Generated by Different Land Uses in the
San Dieguito HU Watershed*
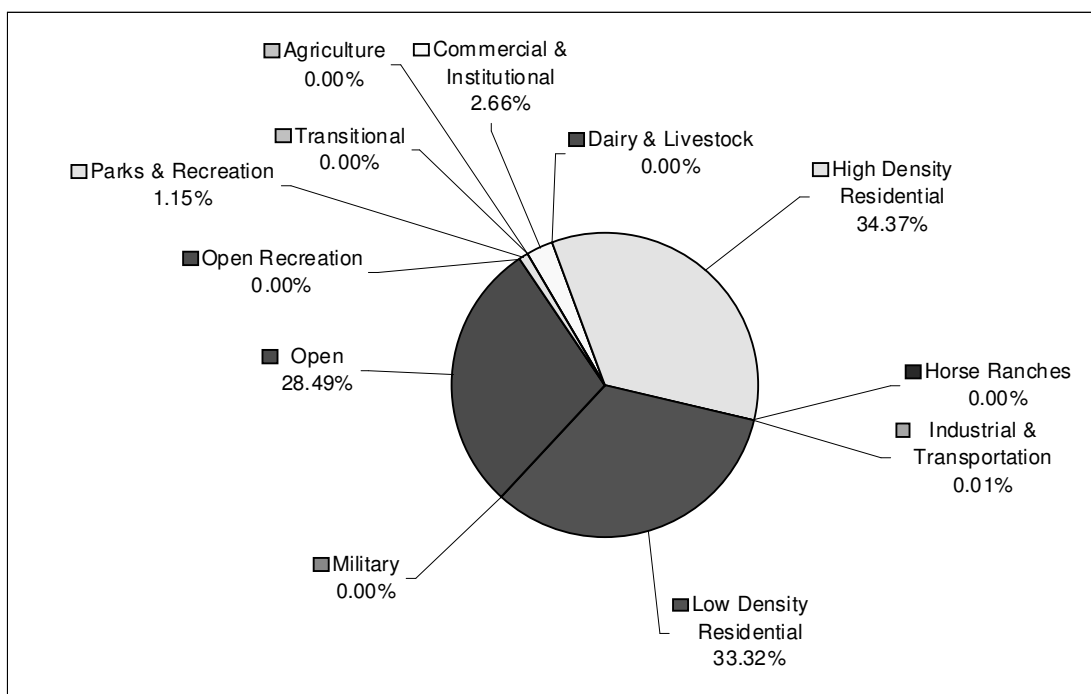
Figure I-3997. Percent of Enterococci Load Generated by Different Land Uses in the Miramar Reservoir HA Watershed
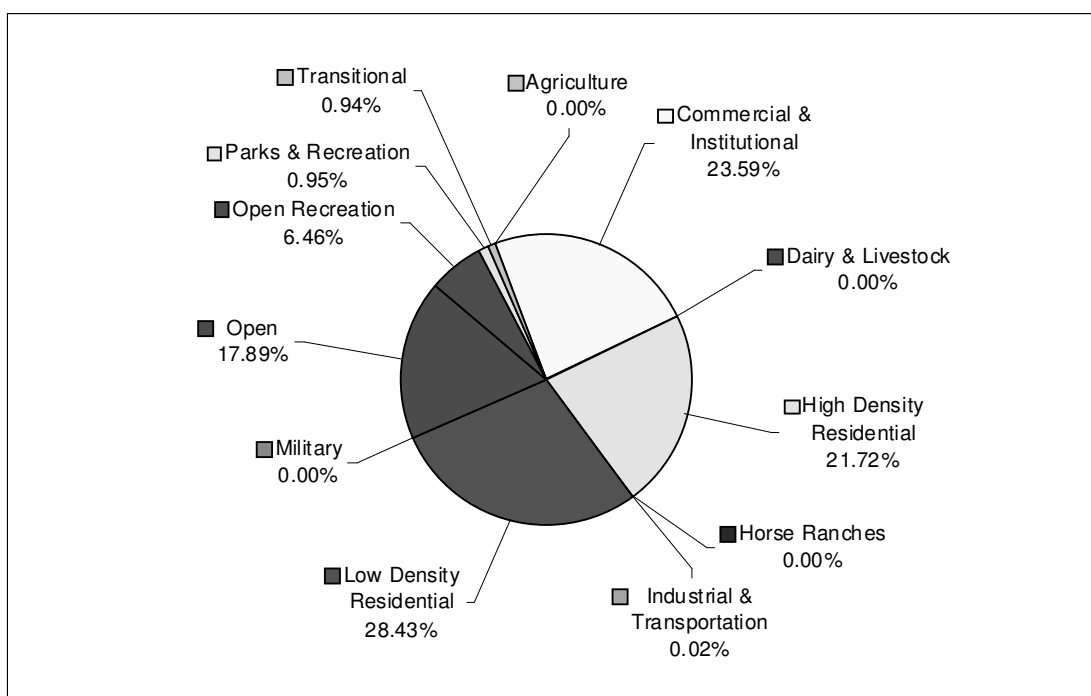
Figure I-4038. Percent of Enterococci Load Generated by Different Land Uses in the Scripps HA Watershed

Commercial/
Institutional, 36.11%

Parks/ Recreation,
1.62%

Open Space,
18.10%

High Density
Residential, 9.70%

Open Recreation,
0.43%

Caltrans, 0.18%

Industrial/
Transportation
(without Caltrans),
0.09%

Low Density
Residential, 33.43%
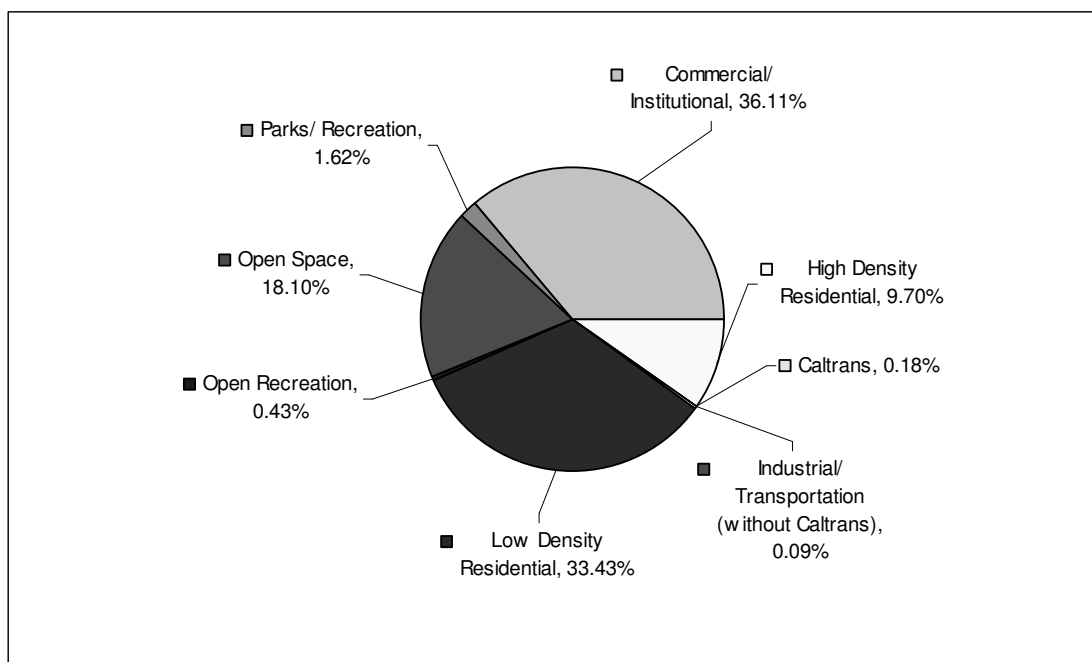
*Figure I-41. Percent of Enterococci Load Generated by Different Land Uses in the
Tecolote HA Watershed*

Parks &
Recreation
0.37%

Open Recreation
0.78%

Transitional
0.34%

Agriculture
2.54%

Commercial &
Institutional
7.05%

Open
74.81%

Dairy & Livestock
0.40%

High Density
Residential
2.98%

Horse Ranches
0.00%

Industrial &
Transportation
0.17%

Low Density
Residential
10.38%

Military
0.18%
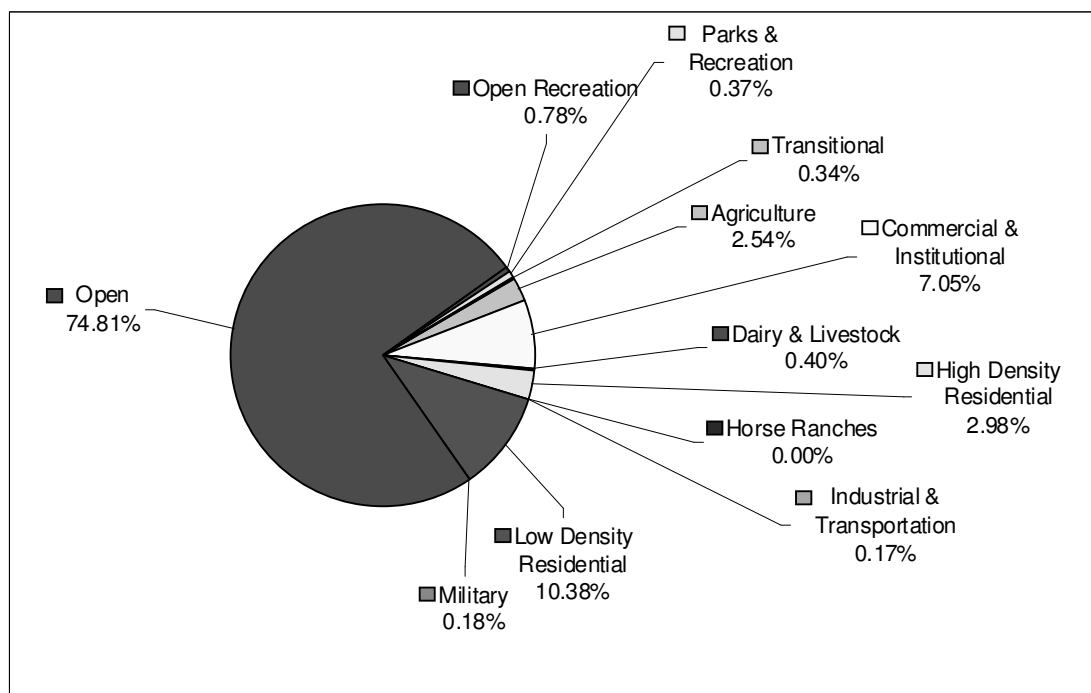
*Figure I-4239. Percent of Enterococci Load Generated by Different Land Uses in the
Mission San Diego HSA/Santee HSA River Watershed*
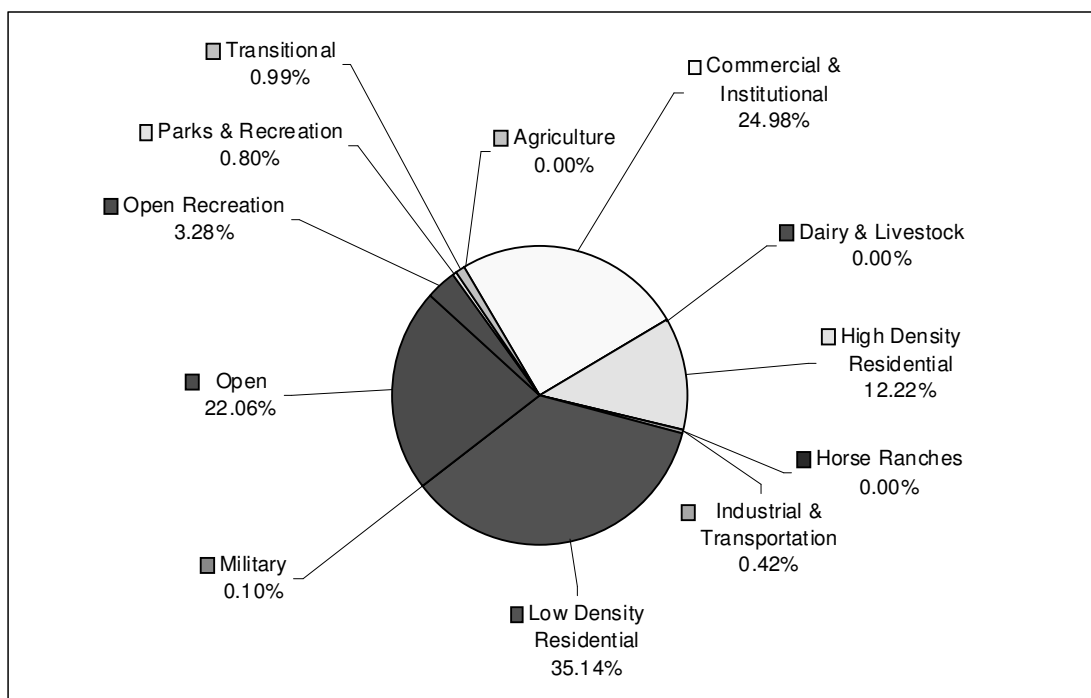
*Figure I-430. Percent of Enterococci Load Generated by Different Land Uses in the Chollas HSA Watershed*

*Table I-12. Fecal Coliform Loads (Billion MPN/year) Generated by Different Land Uses*

Watershed	Municipal MS4							CAL TRANS*	Agriculture/Livestock			Open Space			TOTAL
	COMM/ INST	HIDEN RES	LODEN RES	PARK/ REC	MIL	TRANS	IND/ TRANS*		AGRI	DAIRY/ LIVSTK	HORSE RANCH	OPEN SPACE	OPEN REC	WATER	
San Joaquin Hills HSA/ Laguna Beach HSA	3,123 0.44%	32,219 4.57%	12,911 1.83%	1,065 0.15%	0 0.00%	28,229 4.00%	0 0.00%	179 0.03%	12 0.00%	0 0.00%	7,334 1.04%	619,697 87.90%	245 0.03%	0 0.00%	705,015 100.00%
Aliso HSA	20,935 1.19%	203,419 11.61%	77,956 4.45%	5,649 0.32%	0 0.00%	341,034 19.46%	1,099 0.06%	260 0.01%	16,124 0.92%	0 0.00%	10,384 0.59%	1,047,472 59.78%	27,765 1.58%	0 0.00%	1,752,096 100.00%
Dana Point HSA	2,113 0.52%	77,115 19.09%	27,864 6.90%	2,239 0.55%	0 0.00%	69,712 17.26%	0 0.00%	13 0.00%	0 0.00%	0 0.00%	0 0.00%	199,729 49.45%	25,125 6.22%	0 0.00%	403,911 100.00%
Lower San Juan HSA	49,127 0.32%	255,357 1.67%	217,489 1.42%	12,231 0.08%	0 0.00%	787,171 5.14%	5,093 0.03%	1,713 0.01%	3,119,750 20.38%	0 0.00%	155,727 1.02%	10,480,603 68.48%	220,528 1.44%	0 0.00%	15,304,790 100.00%
San Clemente HA	7,263 0.50%	76,380 5.30%	37,951 2.63%	3,079 0.21%	310 0.02%	128,621 8.92%	1,840 0.13%	335 0.02%	366 0.03%	0 0.00%	0 0.00%	1,147,224 79.57%	38,354 2.66%	0 0.00%	1,441,723 100.00%
San Luis Rey HU	23,591 0.07%	142,670 0.43%	281,805 0.85%	8,795 0.03%	453,236 1.37%	28,477 0.09%	4,927 0.01%	1,537 0.00%	19,290,677 58.24%	1,397,277 4.22%	0 0.00%	11,396,020 34.41%	90,999 0.27%	0 0.00%	33,120,012 100.00%
San Marco HA	912 4.37%	4,705 22.53%	1,614 7.73%	187 0.89%	0 0.00%	645 3.09%	31 0.15%	8 0.04%	4,236 20.28%	6,963 33.34%	0 0.00%	495 2.37%	1,090 5.22%	0 0.00%	20,886 100.00%
San Dieguito HU	56,175 0.26%	121,831 0.57%	380,242 1.79%	9,559 0.04%	0 0.00%	239,782 1.13%	2,419 0.01%	1,310 0.01%	10,735,210 50.43%	1,137,030 5.34%	0 0.00%	8,454,478 39.72%	148,874 0.70%	0 0.00%	21,286,910 100.00%
Miramar Reservoir HA	50 0.48%	5,428 52.23%	1,315 12.66%	46 0.44%	0 0.00%	0 0.00%	1 0.01%	0 0.00%	0 0.00%	0 0.00%	0 0.00%	3,552 34.18%	0 0.00%	0 0.00%	10,392 100.00%
Scripps HA	11,051 5.42%	85,490 41.89%	27,976 13.71%	937 0.46%	0 0.00%	2,910 1.43%	40 0.02%	0 0.00%	0 0.00%	0 0.00%	0 0.00%	55,589 27.24%	20,065 9.83%	0 0.00%	204,057 100.00%
Tecolote HA	29,956 11.44%	67,571 25.79%	58,239 22.23%	3,388 1.29%	14 0.01%	0 0.00%	281 0.11%	553 0.21%	0 0.00%	0 0.00%	0 0.00%	99,585 38.01%	2,378 0.91%	0 0.00%	261,966 100.00%
Mission San Diego HSA/ Santee HSA	56,873 1.15%	202,038 4.10%	175,889 3.57%	6,294 0.13%	9,373 0.19%	17,966 0.36%	4,227 0.09%	1,009 0.02%	358,880 7.28%	55,841 1.13%	0 0.00%	4,002,217 81.14%	41,774 0.85%	0 0.00%	4,932,380 100.00%
Chollas HSA	39,703 6.57%	163,125 27.01%	117,275 19.42%	2,683 0.44%	1,084 0.18%	10,404 1.72%	1,627 0.27%	892 0.15%	0 0.00%	0 0.00%	0 0.00%	232,504 38.50%	34,566 5.72%	0 0.00%	603,863 100.00%

* See Table I-15 for how fecal coliform bacteria loads from Caltrans land use areas are separated from Industrial/Transportation land use areas

Watershed	Low Density Residential	High Density Residential	Commercial/ Institutional	Industrial/ Transport	Military	Parks/Rec	Transitional	Dairy/ Intensive Livestock	Agriculture	Horse Ranches	Open Rec	Open Space	Water	Total Existing Load
Laguna/San Joaquin	12,902	32,219	3,102	212	0	1,058	28,201	0	0	7,332	212	619,708	0	705,015
	1.83%	4.57%	0.44%	0.03%	0.00%	0.15%	4.00%	0.00%	0.00%	1.04%	0.03%	87.90%	0.00%	100%
Aliso Creek -	77,968	203,418	20,850	1,402	0	5,607	340,958	0	16,119	10,337	27,683	1,047,402	0	1,752,095
	4.45%	11.61%	1.19%	0.08%	0.00%	0.32%	19.46%	0.00%	0.92%	0.59%	1.58%	59.78%	0.00%	100%
Dana Point -	27,870	77,107	2,100	0	0	2,222	69,715	0	0	0	25,123	199,734	0	403,911
	6.90%	19.09%	0.52%	0.00%	0.00%	0.55%	17.26%	0.00%	0.00%	0.00%	6.22%	49.45%	0.00%	100%
San Juan Creek	217,328	255,590	48,975	6,122	0	12,244	786,666	0	3,119,116	156,109	220,389	10,480,720	0	15,304,790
	1.42%	1.67%	0.32%	0.04%	0.00%	0.08%	5.14%	0.00%	20.38%	1.02%	1.44%	68.48%	0.00%	100%
San Clemente	37,917	76,411	7,209	2,163	288	3,028	128,601	0	433	0	38,350	1,147,176	0	1,441,719
	2.63%	5.30%	0.50%	0.15%	0.02%	0.21%	8.92%	0.00%	0.03%	0.00%	2.66%	79.57%	0.00%	100%
San Luis Rey River	281,520	142,416	23,184	6,624	453,744	9,936	29,808	1,397,665	19,289,095	0	89,424	11,396,596	0	33,120,012
	0.85%	0.43%	0.07%	0.02%	1.37%	0.03%	0.09%	4.22%	58.24%	0.00%	0.27%	34.41%	0.00%	100%
San Marcos -	1,614	4,706	913	40	0	186	645	6,963	4,236	0	1,090	495	0	20,886
	7.73%	22.53%	4.37%	0.19%	0.00%	0.89%	3.09%	33.34%	20.28%	0.00%	5.22%	2.37%	0.00%	100%
San Dieguito River	381,036	121,335	55,346	4,257	0	8,515	240,542	1,136,721	10,734,988	0	149,008	8,455,160	0	21,286,909
	1.79%	0.57%	0.26%	0.02%	0.00%	0.04%	1.13%	5.34%	50.43%	0.00%	0.70%	39.72%	0.00%	100%
Miramar -	1,316	5,428	50	1	0	46	0	0	0	0	0	3,552	0	10,392
	12.66%	52.23%	0.48%	0.01%	0.00%	0.44%	0.00%	0.00%	0.00%	0.00%	0.00%	34.18%	0.00%	100%
Scripps -	27,976	85,479	11,060	41	0	939	2,918	0	0	0	20,059	55,585	0	204,057
	13.71%	41.89%	5.42%	0.02%	0.00%	0.46%	1.43%	0.00%	0.00%	0.00%	9.83%	27.24%	0.00%	100%
San Diego River	176,086	202,228	56,722	5,426	9,372	6,412	17,757	55,736	359,077	0	41,925	4,002,133	0	4,932,380
	3.57%	4.10%	1.15%	0.11%	0.19%	0.13%	0.36%	1.13%	7.28%	0.00%	0.85%	81.14%	0.00%	100%
Chollas Creek	117,270	163,103	39,674	2,536	1,087	2,657	10,386	0	0	0	34,541	232,487	0	603,863
	19.42%	27.01%	6.57%	0.42%	0.18%	0.44%	1.72%	0.00%	0.00%	0.00%	5.72%	38.50%	0.00%	100%

Table I-13. Total Coliform Loads (Billion MPN/year) Generated by Different Land Uses

| Watershed | Municipal MS4 | | | | | | | CAL TRANS* | Agriculture/Livestock | | | Open Space | | WATER | TOTAL |
	COMM/INST	HIDEN RES	LODEN RES	PARK/REC	MIL	TRANS	IND/TRANS*		AGRI	DAIRY/LIVSTK	HORSE RANCH	OPEN SPACE	OPEN REC		
San Joaquin Hills HSA/ Laguna Beach HSA	215,853 2.63%	742,277 9.03%	371,822 4.52%	30,674 0.37%	0 0.00%	296,278 3.60%	0 0.00%	7,722 0.09%	86 0.00%	0 0.00%	50,688 0.62%	6,503,925 79.10%	2,576 0.03%	0 0.00%	8,221,901 100.00%
Aliso HSA	1,420,213 6.12%	4,599,980 19.82%	2,203,565 9.49%	159,674 0.69%	0 0.00%	3,513,206 15.14%	46,603 0.20%	11,003 0.05%	109,385 0.47%	0 0.00%	70,443 0.30%	10,790,677 46.49%	286,025 1.23%	0 0.00%	23,210,774 100.00%
Dana Point HSA	162,592 2.48%	1,977,554 30.21%	893,185 13.64%	71,764 1.10%	0 0.00%	814,402 12.44%	0 0.00%	634 0.01%	0 0.00%	0 0.00%	0 0.00%	2,333,311 35.64%	293,519 4.48%	0 0.00%	6,546,962 100.00%
Lower San Juan HSA	2,774,700 2.13%	4,807,521 3.69%	5,118,237 3.93%	287,838 0.22%	0 0.00%	6,751,244 5.18%	179,782 0.14%	60,480 0.05%	17,620,337 13.53%	0 0.00%	879,547 0.68%	89,887,797 69.01%	1,891,381 1.45%	0 0.00%	130,258,863 100.00%
San Clemente HA	470,171 2.90%	1,648,096 10.15%	1,023,612 6.30%	83,059 0.51%	3,051 0.02%	1,264,318 7.79%	74,436 0.46%	13,534 0.08%	2,370 0.01%	0 0.00%	0 0.00%	11,276,953 69.45%	377,008 2.32%	0 0.00%	16,236,606 100.00%
San Luis Rey HU	1,338,298 0.58%	2,697,850 1.16%	6,661,047 2.88%	207,883 0.09%	3,904,364 1.69%	245,311 0.11%	174,704 0.08%	54,508 0.02%	109,434,181 47.25%	7,926,619 3.42%	0 0.00%	98,170,007 42.39%	783,906 0.34%	0 0.00%	231,598,677 100.00%
San Marco HA	99,702 19.35%	171,443 33.27%	73,530 14.27%	8,513 1.65%	0 0.00%	10,702 2.08%	2,131 0.41%	533 0.10%	46,303 8.99%	76,110 14.77%	0 0.00%	8,214 1.59%	18,097 3.51%	0 0.00%	515,278 100.00%
San Dieguito HU	3,290,924 2.01%	2,379,081 1.45%	9,281,579 5.68%	233,330 0.14%	0 0.00%	2,133,097 1.30%	88,558 0.05%	47,969 0.03%	62,890,325 38.46%	6,661,091 4.07%	0 0.00%	75,210,801 45.99%	1,324,377 0.81%	0 0.00%	163,541,133 100.00%
Miramar Reservoir HA	3,586 1.68%	129,908 60.99%	39,357 18.48%	1,362 0.64%	0 0.00%	0 0.00%	30 0.01%	9 0.00%	0 0.00%	0 0.00%	0 0.00%	38,734 18.19%	0 0.00%	0 0.00%	212,986 100.00%
Scripps HA	874,595 17.39%	2,255,304 44.84%	922,557 18.34%	30,893 0.61%	0 0.00%	34,969 0.70%	1,993 0.04%	0 0.00%	0 0.00%	0 0.00%	0 0.00%	668,068 13.28%	241,141 4.79%	0 0.00%	5,029,519 100.00%
Tecolote HA	2,352,810 31.81%	1,769,021 23.92%	1,905,887 25.77%	110,886 1.50%	93 0.00%	0 0.00%	13,788 0.19%	27,095 0.37%	0 0.00%	0 0.00%	0 0.00%	1,187,711 16.06%	28,366 0.38%	0 0.00%	7,395,789 100.00%
Mission San Diego HSA/ Santee HSA	4,794,240 6.59%	5,677,064 7.80%	6,177,862 8.49%	221,053 0.30%	119,975 0.16%	229,973 0.32%	222,699 0.31%	53,141 0.07%	3,025,241 4.16%	470,719 0.65%	0 0.00%	51,230,867 70.41%	534,734 0.73%	0 0.00%	72,757,569 100.00%
Chollas HSA	3,251,407 21.13%	4,452,966 28.93%	4,001,695 26.00%	91,547 0.59%	13,477 0.09%	129,379 0.84%	83,294 0.54%	45,652 0.30%	0 0.00%	0 0.00%	0 0.00%	2,891,344 18.79%	429,847 2.79%	0 0.00%	15,390,608 100.00%

* See Table I-16 for how total coliform bacteria loads from Caltrans land use areas are separated from Industrial/Transportation land use areas

Watershed	Low Density Residential	High Density Residential	Commercial/ Institutional	Industrial/ Transport including CalTrans	Military	Parks/Rec	Transitional	Dairy/ Intensive Livestock	Agriculture	Horse Ranches	Open Rec	Open Space	Water	Total Existing Load
Laguna/San Joaquin	371,630	742,438	216,236	7,400	0	30,421	295,988	0	0	50,976	2,467	6,503,524	0	8,221,902
	4.52%	9.03%	2.63%	0.09%	0%	0.37%	3.60%	0%	0%	0.62%	0.03%	79.10%	0%	100%
Aliso Creek -	2,202,702	4,600,375	1,420,499	58,027	0	160,154	3,514,111	0	109,091	69,632	285,493	10,790,689	0	23,210,774
	9.49%	19.82%	6.12%	0.25%	0.00%	0.69%	15.14%	0.00%	0.47%	0.30%	1.23%	46.49%	0.00%	100%
Dana Point -	893,006	1,977,837	162,365	655	0	72,017	814,442	0	0	0	293,304	2,333,337	0	6,546,962
	13.64%	30.21%	2.48%	0.01%	0.00%	1.10%	12.44%	0.00%	0.00%	0.00%	4.48%	35.64%	0.00%	100%
San Juan Creek	5,119,173	4,806,552	2,774,514	234,466	0	286,569	6,747,409	0	17,624,024	885,760	1,888,754	89,891,641	0	130,258,863
	3.93%	3.69%	2.13%	0.18%	0.00%	0.22%	5.18%	0.00%	13.53%	0.68%	1.45%	69.01%	0.00%	100%
San Clemente	1,022,902	1,648,009	470,860	87,677	3,247	82,806	1,264,826	0	1,624	0	376,688	11,276,277	0	16,236,540
	6.30%	10.15%	2.90%	0.54%	0.02%	0.51%	7.79%	0.00%	0.01%	0.00%	2.32%	69.45%	0.00%	100%
San Luis Rey River	6,670,042	2,686,545	1,343,272	231,599	3,914,018	208,439	254,759	7,920,675	109,430,375	0	787,436	98,174,679	0	231,598,677
	2.88%	1.16%	0.58%	0.10%	1.69%	0.09%	0.11%	3.42%	47.25%	0.00%	0.34%	42.39%	0.00%	100%
San Marcos -	73,530	171,433	99,706	2,679	0	8,502	10,718	76,107	46,323	0	18,086	8,193	0	515,278
	14.27%	33.27%	19.35%	0.52%	0.00%	1.65%	2.08%	14.77%	8.99%	0.00%	3.51%	1.59%	0.00%	100%
San Dieguito River	9,289,136	2,371,346	3,287,177	130,833	0	228,958	2,126,035	6,656,124	62,897,919	0	1,324,683	75,212,567	0	163,541,132
	5.68%	1.45%	2.01%	0.08%	0.00%	0.14%	1.30%	4.07%	38.46%	0.00%	0.81%	45.99%	0.00%	100%
Miramar -	39,360	129,900	3,578	43	0	1,363	0	0	0	0	0	38,742	0	212,986
	18.48%	60.99%	1.68%	0.02%	0.00%	0.64%	0.00%	0.00%	0.00%	0.00%	0.00%	18.19%	0.00%	100%
Scripps -	922,414	2,255,236	874,633	2,012	0	30,680	35,207	0	0	0	240,914	667,920	0	5,029,518
	18.34%	44.84%	17.39%	0.04%	0.00%	0.61%	0.70%	0.00%	0.00%	0.00%	4.79%	13.28%	0.00%	100%
San Diego River	6,177,118	5,675,090	4,794,724	276,479	116,412	218,273	232,824	472,924	3,026,715	0	531,130	51,228,604	0	72,757,569
	8.49%	7.80%	6.59%	0.38%	0.16%	0.30%	0.32%	0.65%	4.16%	0.00%	0.73%	70.41%	0.00%	100%
Chollas Creek	4,001,558	4,452,503	3,252,035	129,281	13,852	90,805	129,281	0	0	0	429,398	2,891,895	0	15,390,608
	26.00%	28.93%	21.13%	0.84%	0.09%	0.59%	0.84%	0.00%	0.00%	0.00%	2.79%	18.79%	0.00%	100%

Table I-14. Enterococci Loads (Billion MPN/year) Generated by Different Land Uses

Watershed	Municipal MS4							CAL TRANS*	Agriculture/Livestock			Open Space			TOTAL
	COMM/ INST	HIDEN RES	LODEN RES	PARK/ REC	MIL	TRANS	IND/ TRANS*		AGRI	DAIRY/ LIVSTK	HORSE RANCH	OPEN SPACE	OPEN REC	WATER	
San Joaquin Hills HSA/ Laguna Beach HSA	23,814 2.79%	29,247 3.43%	46,881 5.50%	3,867 0.45%	0 0.00%	32,458 3.81%	0 0.00%	365 0.04%	5 0.00%	0 0.00%	3,195 0.37%	712,533 83.57%	282 0.03%	0 0.00%	852,649 100.00%
Aliso HSA	155,419 6.97%	179,783 8.06%	275,593 12.36%	19,970 0.90%	0 0.00%	381,783 17.12%	2,186 0.10%	516 0.02%	6,840 0.31%	0 0.00%	4,405 0.20%	1,172,631 52.58%	31,083 1.39%	0 0.00%	2,230,206 100.00%
Dana Point HSA	15,131 3.02%	65,726 13.11%	94,996 18.94%	7,633 1.52%	0 0.00%	75,261 15.01%	0 0.00%	25 0.01%	0 0.00%	0 0.00%	0 0.00%	215,628 42.99%	27,125 5.41%	0 0.00%	501,526 100.00%
Lower San Juan HSA	302,177 2.33%	186,986 1.44%	637,026 4.91%	35,825 0.28%	0 0.00%	730,116 5.62%	8,391 0.06%	2,823 0.02%	1,096,531 8.45%	0 0.00%	54,735 0.42%	9,720,946 74.89%	204,544 1.58%	0 0.00%	12,980,098 100.00%
San Clemente HA	51,464 3.09%	64,428 3.87%	128,049 7.70%	10,390 0.62%	332 0.02%	137,426 8.26%	3,492 0.21%	635 0.04%	148 0.01%	0 0.00%	0 0.00%	1,225,757 73.70%	40,979 2.46%	0 0.00%	1,663,100 100.00%
San Luis Rey HU	137,330 0.74%	98,872 0.54%	781,175 4.24%	24,380 0.13%	397,857 2.16%	24,997 0.14%	7,683 0.04%	2,397 0.01%	6,416,957 34.80%	464,798 2.52%	0 0.00%	10,003,592 54.25%	79,881 0.43%	0 0.00%	18,439,920 100.00%
San Marco HA	11,154 27.50%	6,850 16.89%	9,401 23.18%	1,088 2.68%	0 0.00%	1,189 2.93%	102 0.25%	26 0.06%	2,960 7.30%	4,865 12.00%	0 0.00%	912 2.25%	2,010 4.96%	0 0.00%	40,558 100.00%
San Dieguito HU	366,288 2.48%	94,571 0.64%	1,180,642 7.98%	29,680 0.20%	0 0.00%	235,764 1.59%	4,224 0.03%	2,288 0.02%	3,999,911 27.03%	423,655 2.86%	0 0.00%	8,312,808 56.18%	146,379 0.99%	0 0.00%	14,796,210 100.00%
Miramar Reservoir HA	307 2.66%	3,974 34.37%	3,853 33.32%	133 1.15%	0 0.00%	0 0.00%	1 0.01%	0 0.00%	0 0.00%	0 0.00%	0 0.00%	3,295 28.49%	0 0.00%	0 0.00%	11,564 100.00%
Scripps HA	89,116 23.59%	82,072 21.72%	107,432 28.43%	3,597 0.95%	0 0.00%	3,538 0.94%	87 0.02%	0 0.00%	0 0.00%	0 0.00%	0 0.00%	67,598 17.89%	24,399 6.46%	0 0.00%	377,839 100.00%
Tecolote HA	255,786 36.11%	68,685 9.70%	236,798 33.43%	13,777 1.95%	18 0.00%	0 0.00%	644 0.09%	1,266 0.18%	0 0.00%	0 0.00%	0 0.00%	128,222 18.10%	3,062 0.43%	0 0.00%	708,256 100.00%
Mission San Diego HSA/ Santee HSA	511,533 7.05%	216,332 2.98%	753,328 10.38%	26,955 0.37%	12,712 0.18%	24,367 0.34%	10,183 0.14%	2,430 0.03%	184,449 2.54%	28,700 0.40%	0 0.00%	5,428,113 74.81%	56,657 0.78%	0 0.00%	7,255,759 100.00%
Chollas HSA	342,748 24.98%	167,647 12.22%	482,103 35.14%	11,029 0.80%	1,411 0.10%	13,544 0.99%	3,763 0.27%	2,062 0.15%	0 0.00%	0 0.00%	0 0.00%	302,668 22.06%	44,997 3.28%	0 0.00%	1,371,972 100.00%

* See Table I-17 for how *Entercocci* bacteria loads from Caltrans land use areas are separated from Industrial/Transportation land use areas

Watershed	Low Density Residential	High Density Residential	Commercial/ Institutional	Industrial/ Transport	Military	Parks/Rec	Transitional	Dairy/ Intensive Livestock	Agriculture	Horse Ranches	Open Rec	Open Space	Water	Total Existing Load
Laguna/San Joaquin	46,896	29,246	23,789	341	0	3,837	32,571	0	0	3,155	256	712,559	0	852,649
	5.50%	3.43%	2.79%	0.04%	0%	0.45%	3.82%	0%	0%	0.37%	0.03%	83.57%	0%	100%
Aliso Creek	275,653	179,755	155,445	2,676	0	20,072	381,811	0	6,914	4,460	31,000	1,172,642	0	2,230,206
-	12.36%	8.06%	6.97%	0.12%	0.00%	0.90%	17.12%	0.00%	0.31%	0.20%	1.39%	52.58%	0.00%	100%
Dana Point	94,989	65,750	15,146	50	0	7,623	75,229	0	0	0	27,133	215,606	0	501,525
-	18.94%	13.11%	3.02%	0.01%	0.00%	1.52%	15.00%	0.00%	0.00%	0.00%	5.41%	42.99%	0.00%	100%
San Juan Creek	637,323	186,913	302,436	11,682	0	36,344	729,482	0	1,096,818	54,516	205,086	9,720,795	0	12,980,098
	4.91%	1.44%	2.33%	0.09%	0.00%	0.28%	5.62%	0.00%	8.45%	0.42%	1.58%	74.89%	0.00%	100%
San Clemente	128,058	64,362	51,390	4,158	333	10,311	137,371	0	166	0	40,912	1,225,700	0	1,663,093
	7.70%	3.87%	3.09%	0.25%	0.02%	0.62%	8.26%	0.00%	0.01%	0.00%	2.46%	73.70%	0.00%	100%
San Luis Rey River	781,853	99,576	136,455	9,220	398,302	23,972	25,816	464,686	6,417,092	0	79,292	10,003,657	0	18,439,920
	4.24%	0.54%	0.74%	0.05%	2.16%	0.13%	0.14%	2.52%	34.80%	0.00%	0.43%	54.25%	0.00%	100%
San Marcos	9,401	6,850	11,153	126	0	1,087	1,188	4,867	2,961	0	2,012	913	0	40,558
-	23.18%	16.89%	27.50%	0.31%	0.00%	2.68%	2.93%	12.00%	7.30%	0.00%	4.96%	2.25%	0.00%	100%
San Dieguito River	1,180,738	94,696	366,946	5,918	0	29,592	235,260	423,172	3,999,416	0	146,482	8,313,990	0	14,796,210
	7.98%	0.64%	2.48%	0.04%	0.00%	0.20%	1.59%	2.86%	27.03%	0.00%	0.99%	56.19%	0.00%	100%
Miramar	3,853	3,975	308	1	0	133	0	0	0	0	0	3,295	0	11,564
-	33.32%	34.37%	2.66%	0.01%	0.00%	1.15%	0.00%	0.00%	0.00%	0.00%	0.00%	28.49%	0.00%	100%
Scripps	107,420	82,067	89,132	76	0	3,589	3,552	0	0	0	24,408	67,595	0	377,839
-	28.43%	21.72%	23.59%	0.02%	0.00%	0.95%	0.94%	0.00%	0.00%	0.00%	6.46%	17.89%	0.00%	100%
San Diego River	753,148	216,222	511,531	12,335	13,060	26,846	24,670	29,023	184,296	0	56,595	5,428,033	0	7,255,759
	10.38%	2.98%	7.05%	0.17%	0.18%	0.37%	0.34%	0.40%	2.54%	0.00%	0.78%	74.81%	0.00%	100%
Chollas Creek	482,111	167,655	342,719	5,762	1,372	10,976	13,583	0	0	0	45,001	302,657	0	1,371,972
	35.14%	12.22%	24.98%	0.42%	0.10%	0.80%	0.99%	0.00%	0.00%	0.00%	3.28%	22.06%	0.00%	100%

Table I-15. Loads Generated by Caltrans: Fecal Coliform

Watershed	IND/ TRANS Land Use Total Load [a] (Billion MPN/yr)	IND/TRANS GIS-Based Land Use Area [b] (sq mi)	CALTRANS Land Use Area [c] (sq mi)	IND/ TRANS Land Use w/o CALTRANS Land Use			IND/TRANS Land Use Occupied by CALTRANS Land Use		
				Land Use Area		Bacteria Load	Land Use Area		Bacteria Load
				(percent)	(sq mi)	(Billion MPN/yr)	(percent)	(sq mi)	(Billion MPN/yr)
San Joaquin Hills HSA/Laguna Beach HSA [d]	179	0.11	0.19	100.00%	0.11	179	0.00%	0	0
Aliso HSA	1,359	0.89	0.17	19.10%	0.17	260	80.90%	0.72	1,099
Dana Point HSA [ad]	13	0.01	0.06	100.00%	0.01	13	0.00%	0	0
Lower San Juan HSA	6,806	2.9	0.73	25.17%	0.73	1,713	74.83%	2.17	5,093
San Clemente HA	2,174	1.17	0.18	15.38%	0.18	335	84.62%	0.99	1,840
San Luis Rey HU	6,465	4.92	1.17	23.78%	1.17	1,537	76.22%	3.75	4,927
San Marcos HA	39	0.05	0.01	20.00%	0.01	8	80.00%	0.04	31
San Dieguito HU	3,729	2.22	0.78	35.14%	0.78	1,310	64.86%	1.44	2,419
Miramar Reservoir HA	1	3.28	0.74	22.56%	0.74	0	77.44%	2.54	1
Scripps HA	40	0.05	0	0.00%	0	0	100.00%	0.05	40
Tecolote HA	834	0.36	0.24	66.27%	0.24	553	33.73%	0.12	281
Mission San Diego HSA/Santee HSA	5,236	10.07	1.94	19.27%	1.94	1,009	80.73%	8.13	4,227
Chollas HSA	2,519	1.61	0.57	35.40%	0.57	892	64.60%	1.04	1,627

a. Total bacteria load generated by Industrial/Transportation land use area calculated by multiplying the total existing load (see Table I-3) by the percent load generated by Industrial & Transportation from Figures I-5 through I-40.
b. Total Industrial/Transportation land use area from GIS land use data (SANDAG 2000)
c. Total Caltrans land use area reported by Caltrans (Richard Watson, Caltrans, personal communication, September 23, 2005)
d. Caltrans reported area greater than GIS-based land use area in this watershed, therefore 100 percent of load was assumed to be generated by Caltrans land use area.

Watershed	Measure/Unit	Industrial/Transport including CalTrans	Industrial/ Transport excluding Caltrans	Caltrans

Laguna/San Joaquin	Area (sq miles)	0.11		0.19
	% Area of Ind./Trans		0.00%	
-	Load (Billion MPN/Yr)	212	0	212
Aliso Creek	Area (sq miles)	0.89	0.72	0.17
-	% Area of Ind./Trans		80.90%	19.10%
-	Load (Billion MPN/Yr)	1,402	1,134	268
Dana Point	Area (sq miles)	0.01		0.06
-	% Area of Ind./Trans		0.00%	
-	Load (Billion MPN/Yr)	0	0	0
San Juan Creek	Area (sq miles)	2.9	2.17	0.73
	% Area of Ind./Trans		74.83%	25.17%
-	Load (Billion MPN/Yr)	6,122	4,581	1,541
San Clemente	Area (sq miles)	1.17	0.99	0.18
	% Area of Ind./Trans		84.62%	15.38%
-	Load (Billion MPN/Yr)	2,163	1,830	333
San Luis Rey River	Area (sq miles)	4.92	3.75	1.17
	% Area of Ind./Trans		76.22%	23.78%
-	Load (Billion MPN/Yr)	6,624	5,049	1,575
San Marcos	Area (sq miles)	0.05	0.04	0.01
-	% Area of Ind./Trans		80.00%	20.00%
-	Load (Billion MPN/Yr)	40	32	8
San Dieguito River	Area (sq miles)	2.22	1.44	0.78
	% Area of Ind./Trans		64.86%	35.14%
-	Load (Billion MPN/Yr)	4,257	2,762	1,496
Miramar	Area (sq miles)	3.28	2.54	0.74
-	% Area of Ind./Trans		77.44%	22.56%
-	Load (Billion MPN/Yr)	1	1	0
Scripps	Area (sq miles)	0.05	0.05	0
-	% Area of Ind./Trans		100.00%	0.00%
-	Load (Billion MPN/Yr)	41	41	0
San Diego River	Area (sq miles)	10.07	8.13	1.94
	% Area of Ind./Trans		80.73%	19.27%

-	Load (Billion MPN/Yr)		5,426	4,380	1,045
Chollas Creek	Area (sq miles)		1.61	1.04	0.57
	% Area of Ind./Trans	-		64.60%	35.40%
-	Load (Billion MPN/Yr)		2,536	1,638	898

Table I-16. Loads Generated by Caltrans: Total Coliform

Watershed	IND/ TRANS Land Use Total Load [a] (Billion MPN/yr)	IND/TRANS GIS-Based Land Use Area [b] (sq mi)	CALTRANS Land Use Area [c] (sq mi)	IND/ TRANS Land Use w/o CALTRANS Land Use			IND/TRANS Land Use Occupied by CALTRANS Land Use		
				Land Use Area		Bacteria Load	Land Use Area		Bacteria Load
				(percent)	(sq mi)	(Billion MPN/yr)	(percent)	(sq mi)	(Billion MPN/yr)
San Joaquin Hills HSA/Laguna Beach HSA [d]	7,722	0.11	0.19	100.00%	0.11	7,722	0.00%	0	0
Aliso HSA	57,606	0.89	0.17	19.10%	0.17	11,003	80.90%	0.72	46,603
Dana Point HSA [d]	634	0.01	0.06	100.00%	0.01	634	0.00%	0	0
Lower San Juan HSA	240,261	2.9	0.73	25.17%	0.73	60,480	74.83%	2.17	179,782
San Clemente HA	87,970	1.17	0.18	15.38%	0.18	13,534	84.62%	0.99	74,436
San Luis Rey HU	229,211	4.92	1.17	23.78%	1.17	54,508	76.22%	3.75	174,704
San Marcos HA	2,664	0.05	0.01	20.00%	0.01	533	80.00%	0.04	2,131
San Dieguito HU	136,527	2.22	0.78	35.14%	0.78	47,969	64.86%	1.44	88,558
Miramar Reservoir HA	39	3.28	0.74	22.56%	0.74	9	77.44%	2.54	30
Scripps HA	1,993	0.05	0	0.00%	0	0	100.00%	0.05	1,993
Tecolote HA	40,883	0.36	0.24	66.27%	0.24	27,095	33.73%	0.12	13,788
Mission San Diego HSA/Santee HSA	275,840	10.07	1.94	19.27%	1.94	53,141	80.73%	8.13	222,699
Chollas HSA	128,945	1.61	0.57	35.40%	0.57	45,652	64.60%	1.04	83,294

a. Total bacteria load generated by Industrial/Transportation land use area calculated by multiplying the total existing load (see Table I-3) by the percent load generated by Industrial & Transportation from Figures I-5 through I-40.
b. Total Industrial/Transportation land use area from GIS land use data (SANDAG 2000)
c. Total Caltrans land use area reported by Caltrans (Richard Watson, Caltrans, personal communication, September 23, 2005)
d. Caltrans reported area greater than GIS-based land use area in this watershed, therefore 100 percent of load was assumed to be generated by Caltrans land use area.

Watershed	Measure/Unit	Industrial/ Transport	Industrial/ Transport excluding Caltrans	Caltrans

Laguna/San Joaquin	Area (sq miles)	0.11		0.19
	% Area of Ind./Trans	0.79%	0.00%	
-	Load (Billion MPN/Yr)	7,400	0	7,400
Aliso Creek	Area (sq miles)	0.89	0.72	0.17
-	% Area of Ind./Trans	2.49%	80.90%	19.10%
-	Load (Billion MPN/Yr)	58,027	46,943	11,084
Dana Point	Area (sq miles)	0.01		0.06
-	% Area of Ind./Trans	0.11%	0.00%	
-	Load (Billion MPN/Yr)	655	0	655
San Juan Creek	Area (sq miles)	2.9	2.17	0.73
	% Area of Ind./Trans	1.64%	74.83%	25.17%
-	Load (Billion MPN/Yr)	234,466	175,445	59,021
San Clemente	Area (sq miles)	1.17	0.99	0.18
	% Area of Ind./Trans	6.23%	84.62%	15.38%
-	Load (Billion MPN/Yr)	87,677	74,188	13,489
San Luis Rey River	Area (sq miles)	4.92	3.75	1.17
	% Area of Ind./Trans	0.88%	76.22%	23.78%
-	Load (Billion MPN/Yr)	231,599	176,523	55,075
San Marcos	Area (sq miles)	0.05	0.04	0.01
-	% Area of Ind./Trans	3.50%	80.00%	20.00%
-	Load (Billion MPN/Yr)	2,679	2,144	536
San Dieguito River	Area (sq miles)	2.22	1.44	0.78
	% Area of Ind./Trans	0.64%	64.86%	35.14%
-	Load (Billion MPN/Yr)	130,833	84,865	45,968
Miramar	Area (sq miles)	3.28	2.54	0.74
-	% Area of Ind./Trans	3.50%	77.44%	22.56%
-	Load (Billion MPN/Yr)	43	33	10
Scripps	Area (sq miles)	0.05	0.05	0
-	% Area of Ind./Trans	0.57%	100.00%	0.00%
-	Load (Billion MPN/Yr)	2,012	2,012	0
San Diego River	Area (sq miles)	10.07	8.13	1.94
	% Area of Ind./Trans	2.31%	80.73%	19.27%

-	Load (Billion MPN/Yr)	276,479	223,215	53,264
Chollas Creek	Area (sq miles)	1.61	1.04	0.57
	% Area of Ind./Trans	6.01%	64.60%	35.40%
-	Load (Billion MPN/Yr)	129,281	83,511	45,770

Table I-17. Loads Generated by Caltrans: Enterococci

Watershed	IND/ TRANS Land Use Total Load [a] (Billion MPN/yr)	IND/TRANS GIS-Based Land Use Area [b] (sq mi)	CALTRANS Land Use Area [c] (sq mi)	IND/ TRANS Land Use w/o CALTRANS Land Use			IND/TRANS Land Use Occupied by CALTRANS Land Use		
				Land Use Area (percent)	(sq mi)	Bacteria Load (Billion MPN/yr)	Land Use Area (percent)	(sq mi)	Bacteria Load (Billion MPN/yr)
San Joaquin Hills HSA/Laguna Beach HSA [d]	365	0.11	0.19	100.00%	0.11	365	0.00%	0	0
Aliso HSA	2,702	0.89	0.17	19.10%	0.17	516	80.90%	0.72	2,186
Dana Point HSA [d]	25	0.01	0.06	100.00%	0.01	25	0.00%	0	0
Lower San Juan HSA	11,214	2.9	0.73	25.17%	0.73	2,823	74.83%	2.17	8,391
San Clemente HA	4,127	1.17	0.18	15.38%	0.18	635	84.62%	0.99	3,492
San Luis Rey HU	10,080	4.92	1.17	23.78%	1.17	2,397	76.22%	3.75	7,683
San Marcos HA	128	0.05	0.01	20.00%	0.01	26	80.00%	0.04	102
San Dieguito HU	6,512	2.22	0.78	35.14%	0.78	2,288	64.86%	1.44	4,224
Miramar Reservoir HA	1	3.28	0.74	22.56%	0.74	0	77.44%	2.54	1
Scripps HA	87	0.05	0	0.00%	0	0	100.00%	0.05	87
Tecolote HA	1,910	0.36	0.24	66.27%	0.24	1,266	33.73%	0.12	644
Mission San Diego HSA/Santee HSA	12,613	10.07	1.94	19.27%	1.94	2,430	80.73%	8.13	10,183
Chollas HSA	5,826	1.61	0.57	35.40%	0.57	2,062	64.60%	1.04	3,763

a. Total bacteria load generated by Industrial/Transportation land use area calculated by multiplying the total existing load (see Table I-3) by the percent load generated by Industrial & Transportation from Figures I-5 through I-40.
b. Total Industrial/Transportation land use area from GIS land use data (SANDAG 2000)
c. Total Caltrans land use area reported by Caltrans (Richard Watson, Caltrans, personal communication, September 23, 2005)
d. Caltrans reported area greater than GIS-based land use area in this watershed, therefore 100 percent of load was assumed to be generated by Caltrans land use area.

Watershed	Measure/Unit	Industrial/ Transport	Industrial/ Transport excluding Caltrans	Caltrans
Laguna/San	Area (sq miles)	0.11		0.19

Joaquin	% Area of Ind./Trans		0.00%	
-	Load (Billion MPN/Yr)	341	0	341
Aliso Creek	Area (sq miles)	0.89	0.72	0.17
-	% Area of Ind./Trans		80.90%	19.10%
-	Load (Billion MPN/Yr)	2,676	2,165	511
Dana Point	Area (sq miles)	0.01		0.06
-	% Area of Ind./Trans		0.00%	
-	Load (Billion MPN/Yr)	50	0	50
San Juan Creek	Area (sq miles)	2.9	2.17	0.73
	% Area of Ind./Trans		74.83%	25.17%
-	Load (Billion MPN/Yr)	11,682	8,741	2,941
San Clemente	Area (sq miles)	1.17	0.99	0.18
	% Area of Ind./Trans		84.62%	15.38%
-	Load (Billion MPN/Yr)	4,158	3,518	640
San Luis Rey River	Area (sq miles)	4.92	3.75	1.17
	% Area of Ind./Trans		76.22%	23.78%
-	Load (Billion MPN/Yr)	9,220	7,027	2,193
San Marcos	Area (sq miles)	0.05	0.04	0.01
-	% Area of Ind./Trans		80.00%	20.00%
-	Load (Billion MPN/Yr)	126	101	25
San Dieguito River	Area (sq miles)	2.22	1.44	0.78
	% Area of Ind./Trans		64.86%	35.14%
-	Load (Billion MPN/Yr)	5,918	3,839	2,079
Miramar	Area (sq miles)	3.28	2.54	0.74
-	% Area of Ind./Trans		77.44%	22.56%
-	Load (Billion MPN/Yr)	1	1	0
Scripps	Area (sq miles)	0.05	0.05	0
-	% Area of Ind./Trans		100.00%	0.00%
-	Load (Billion MPN/Yr)	76	76	0
San Diego River	Area (sq miles)	10.07	8.13	1.94
	% Area of Ind./Trans		80.73%	19.27%
-	Load (Billion MPN/Yr)	12,335	9,958	2,376

Chollas Creek -	Area (sq miles)	1.61	1.04	0.57
	% Area of Ind./Trans		64.60%	35.40%
	Load (Billion MPN/Yr)	5,762	3,722	2,040

Table I-18. Wet Weather Fecal Coliform Loads: Percent Reduction Required to Meet Wet Weather TMDLs

Watershed	Total			Point Sources				Nonpoint Sources			
				MS4		Caltrans		Ag/Livestock		Open Space	
	Existing Load	TMDL	Reduction Required	WLA	Reduction Required	WLA	Reduction Required	LA	Reduction Required	LA	Reduction Required
San Joaquin Hills HSA/ Laguna Beach HSA [d]	705,015	664,634	5.73%	37,167	52.07%	179	0.00%	7,346	0.00%	619,942	0.00%
Aliso HSA	1,752,096	1,579,073	9.88%	477,069	26.62%	260	0.00%	26,508	0.00%	1,075,237	0.00%
Dana Point HSA [d]	403,911	377,313	6.59%	152,446	14.86%	13	0.00%	0	0.00%	224,854	0.00%
Lower San Juan HSA	15,304,790	14,714,833	3.85%	1,156,419	12.82%	1,713	0.00%	2,855,570	12.82%	10,701,131	0.00%
San Clemente HA	1,441,723	1,378,931	4.36%	192,653	24.58%	335	0.00%	366	0.00%	1,185,577	0.00%
San Luis Rey HU	33,120,012	32,444,242	2.04%	914,026	3.12%	1,537	0.00%	20,041,659	3.12%	11,487,019	0.00%
San Marcos HA	20,886	17,224	17.53%	6,558	18.98%	8	0.00%	9,073	18.98%	1,585	0.00%
San Dieguito HU	21,286,910	21,101,649	0.87%	798,175	1.46%	1,310	0.00%	11,698,811	1.46%	8,603,352	0.00%
Miramar Reservoir HA	10,392	10,256	1.31%	6,703	1.99%	0	0.00%	0	0.00%	3,552	0.00%
Scripps HA	204,057	176,907	13.31%	101,253	21.14%	0	0.00%	0	0.00%	75,654	0.00%
Tecolote HA	261,966	229,322	12.46%	126,806	20.47%	553	0.00%	0	0.00%	101,963	0.00%
Mission San Diego HSA/ Santee HSA	4,932,380	4,680,838	5.10%	221,117	53.22%	1,009	0.00%	414,721	0.00%	4,043,991	0.00%
Chollas HSA	603,863	520,440	13.81%	252,479	24.84%	892	0.00%	0	0.00%	267,070	0.00%

Table I-19. Wet Weather Total Coliform Loads: Percent Reduction Required to Meet Wet Weather TMDLs

| Watershed | Total | | | Point Sources | | | | Nonpoint Sources | | | |
| | | | | MS4 | | Caltrans | | Ag/Livestock | | Open Space | |
	Existing Load	TMDL	Reduction Required	WLA	Reduction Required	WLA	Reduction Required	LA	Reduction Required	LA	Reduction Required
San Joaquin Hills HSA/ Laguna Beach HSA [d]	8,221,901	7,445,649	9.44%	880,652	46.85%	7,722	0.00%	50,774	0.00%	6,506,501	0.00%
Aliso HSA	23,210,774	20,190,798	13.01%	8,923,264	25.29%	11,003	0.00%	179,828	0.00%	11,076,702	0.00%
Dana Point HSA [d]	6,546,962	6,031,472	7.87%	3,404,008	13.15%	634	0.00%	0	0.00%	2,626,830	0.00%
Lower San Juan HSA	130,258,863	122,879,189	5.67%	16,093,160	19.21%	60,480	0.00%	14,946,372	19.21%	91,779,178	0.00%
San Clemente HA	16,236,606	15,147,603	6.71%	3,477,739	23.85%	13,534	0.00%	2,370	0.00%	11,653,960	0.00%
San Luis Rey HU	231,598,677	224,150,535	3.22%	14,373,954	5.62%	54,508	0.00%	110,768,160	5.62%	98,953,913	0.00%
San Marcos HA	515,278	425,083	17.50%	298,430	18.47%	533	0.00%	99,809	18.47%	26,311	0.00%
San Dieguito HU	163,541,133	159,814,184	2.28%	16,660,538	4.29%	47,969	0.00%	66,570,499	4.29%	76,535,178	0.00%
Miramar Reservoir HA	212,986	210,180	1.32%	171,436	1.61%	9	0.00%	0	0.00%	38,734	0.00%
Scripps HA	5,029,519	4,356,973	13.37%	3,447,764	16.32%	0	0.00%	0	0.00%	909,209	0.00%
Tecolote HA	7,395,789	6,379,770	13.74%	5,136,598	16.51%	27,095	0.00%	0	0.00%	1,216,077	0.00%
Mission San Diego HSA/ Santee HSA	72,757,569	66,105,222	9.14%	10,790,520	38.14%	53,141	0.00%	3,495,960	0.00%	51,765,601	0.00%
Chollas HSA	15,390,608	13,247,626	13.92%	9,880,784	17.82%	45,652	0.00%	0	0.00%	3,321,191	0.00%

Table I-20. Wet Weather Enterococci Loads: Percent Reduction Required to Meet Wet Weather TMDLs

| Watershed | Total | | | Point Sources | | | | Nonpoint Sources | | | |
| | | | | MS4 | | Caltrans | | Ag/Livestock | | Open Space | |
	Existing Load	TMDL	Reduction Required	WLA	Reduction Required	WLA	Reduction Required	LA	Reduction Required	LA	Reduction Required
San Joaquin Hills HSA/ Laguna Beach HSA [d]	852,649	782,799	8.19%	66,417	51.26%	365	0.00%	3,201	0.00%	712,816	0.00%
Aliso HSA	2,230,206	1,950,964	12.52%	735,490	27.52%	516	0.00%	11,245	0.00%	1,203,713	0.00%
Dana Point HSA [d]	501,526	462,306	7.82%	219,528	15.16%	25	0.00%	0	0.00%	242,753	0.00%
Lower San Juan HSA	12,980,098	12,152,446	6.38%	1,385,094	27.12%	2,823	0.00%	839,040	27.12%	9,925,490	0.00%
San Clemente HA	1,663,100	1,563,187	6.01%	295,668	25.26%	635	0.00%	148	0.00%	1,266,736	0.00%
San Luis Rey HU	18,439,920	17,463,618	5.29%	1,300,235	11.69%	2,397	0.00%	6,077,514	11.69%	10,083,473	0.00%
San Marcos HA	40,558	32,966	18.72%	23,771	20.19%	26	0.00%	6,246	20.19%	2,923	0.00%
San Dieguito HU	14,796,210	14,307,087	3.31%	1,763,603	7.72%	2,288	0.00%	4,082,010	7.72%	8,459,187	0.00%
Miramar Reservoir HA	11,564	11,405	1.38%	8,109	1.93%	0	0.00%	0	0.00%	3,295	0.00%
Scripps HA	377,839	324,032	14.24%	232,035	18.82%	0	0.00%	0	0.00%	91,997	0.00%
Tecolote HA	708,256	603,761	14.75%	471,211	18.15%	1,266	0.00%	0	0.00%	131,284	0.00%
Mission San Diego HSA/ Santee HSA	7,255,759	6,590,966	9.16%	890,617	42.74%	2,430	0.00%	213,149	0.00%	5,484,770	0.00%
Chollas HSA	1,371,972	1,152,645	15.99%	802,918	21.46%	2,062	0.00%	0	0.00%	347,665	0.00%
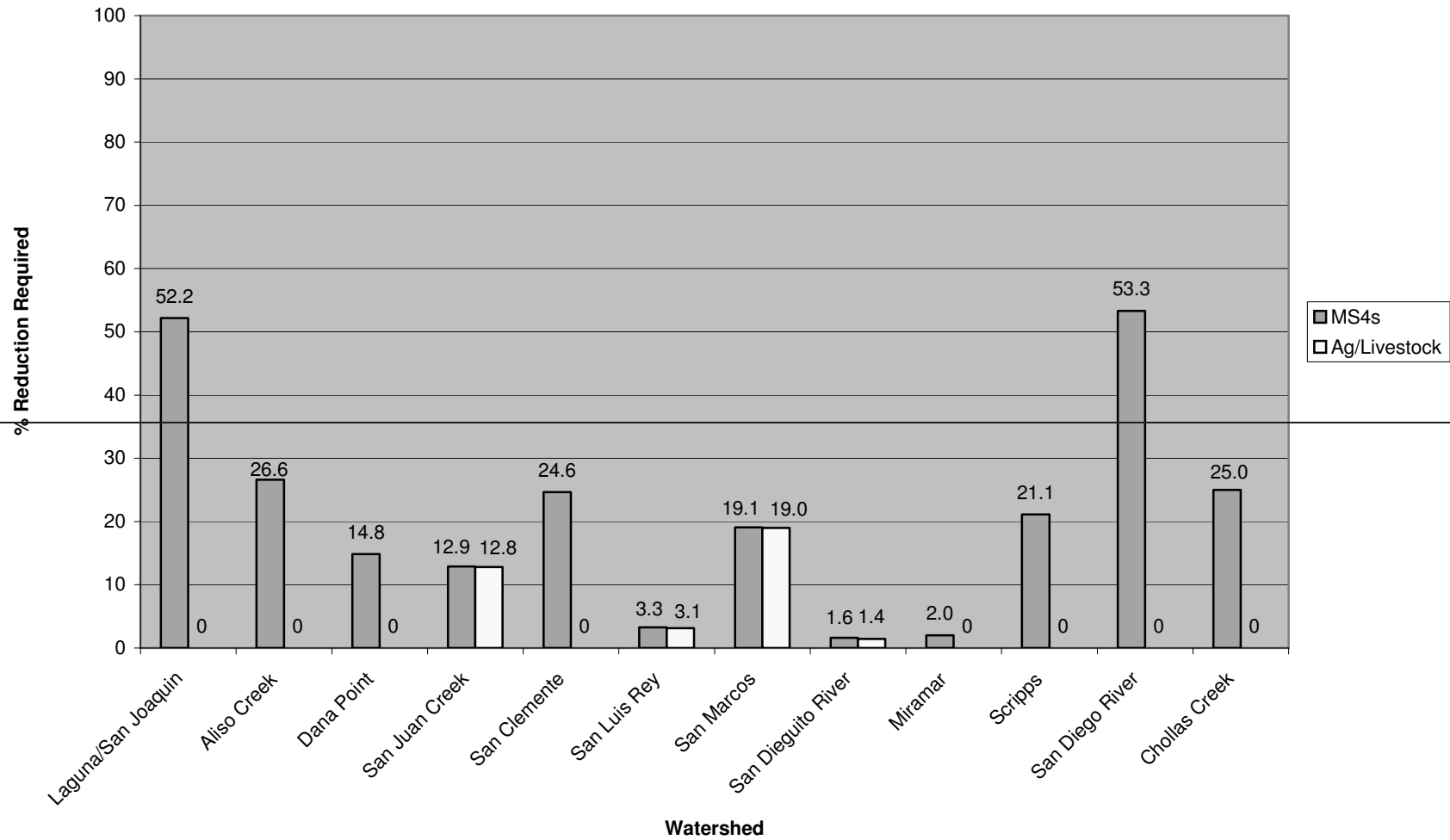
Figure I-41. Wet Weather Fecal Coliform Loads: Percent Reduction Required from Controllable Sources to Meet Interim TMDLs
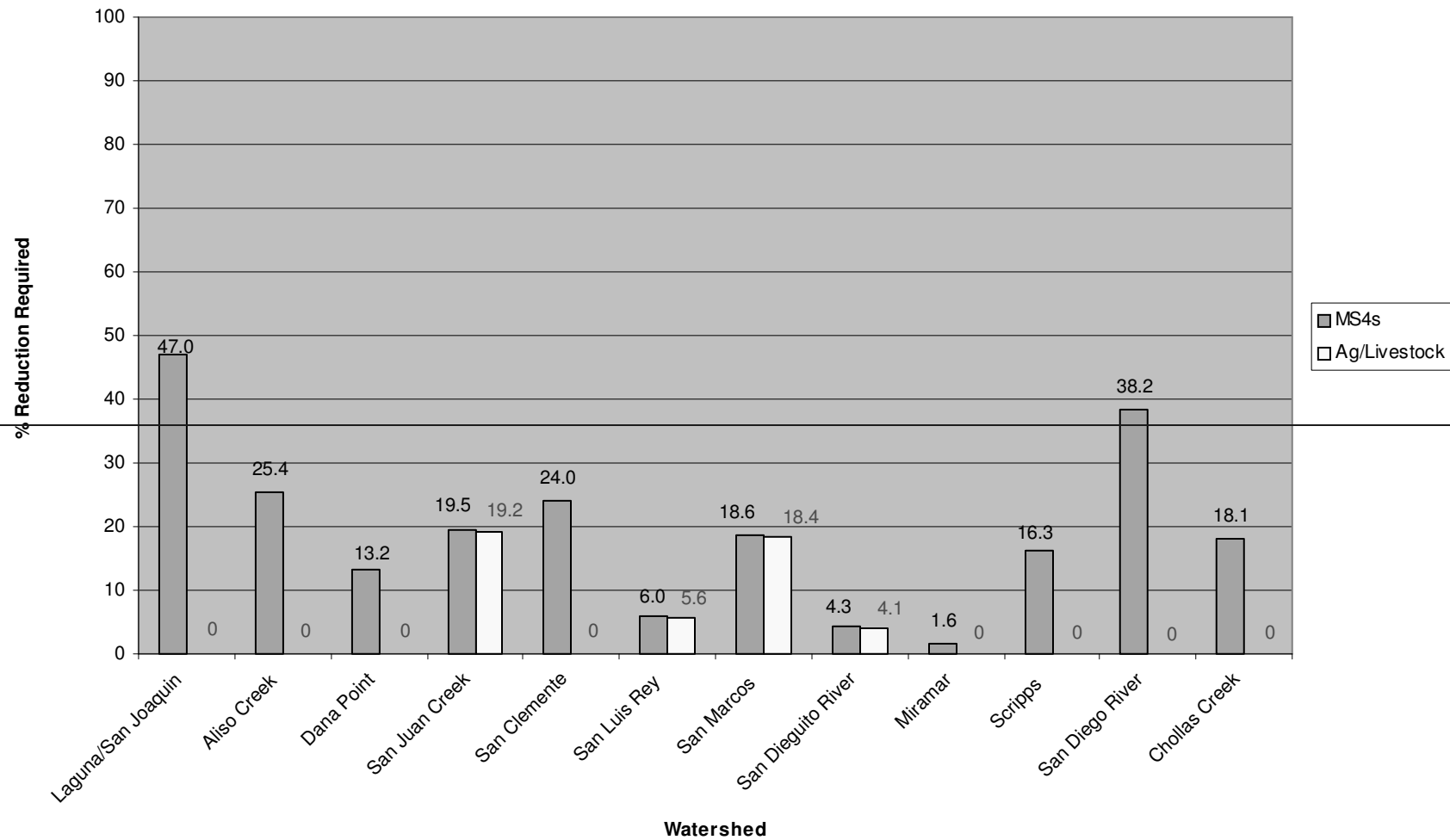
Figure I-42. Wet Weather Total Coliform Loads: Percent Reduction Required from Controllable Sources to Meet Interim TMDLs
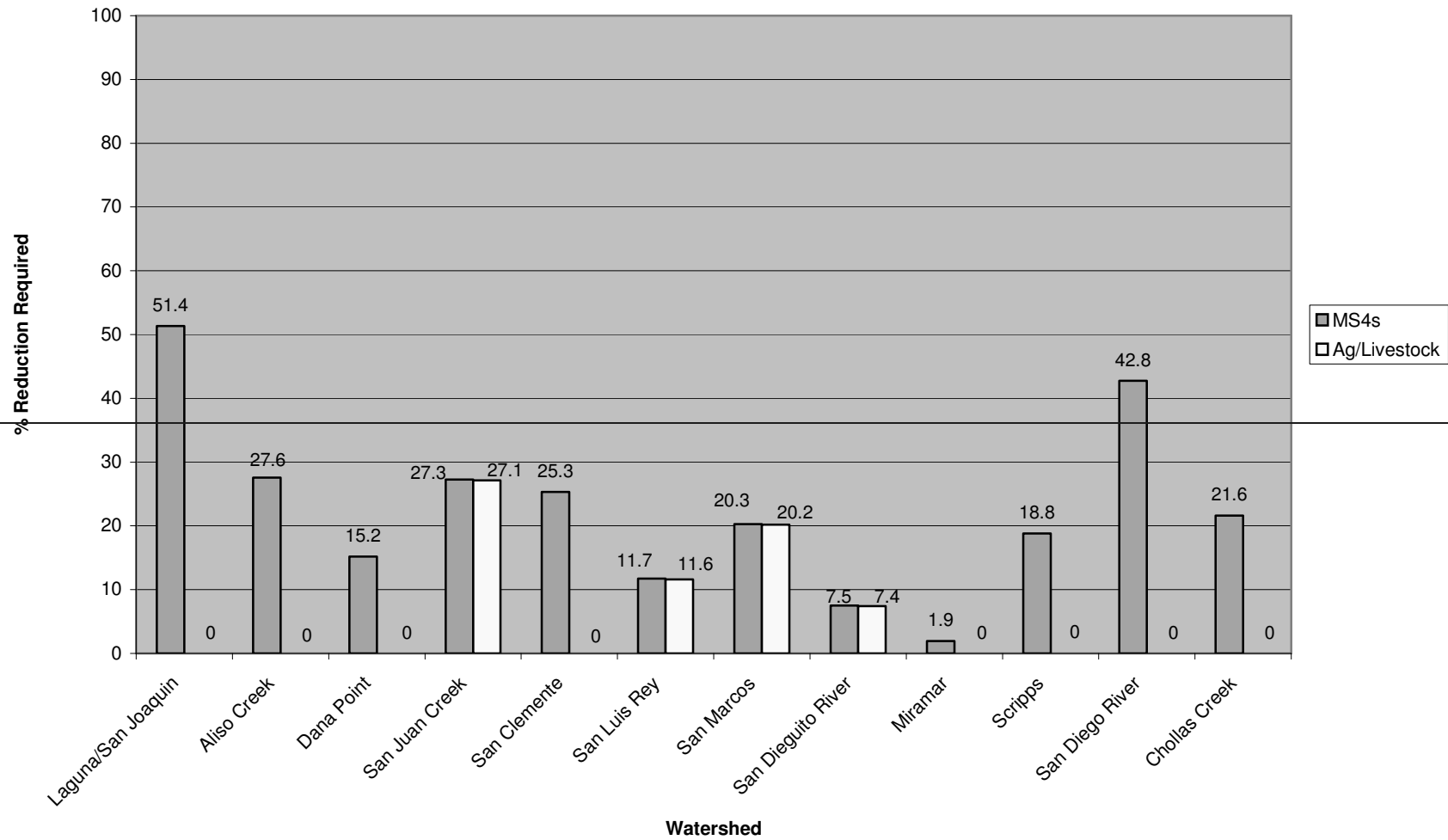
Figure I-43. Wet Weather Enterococci Loads: Percent Reduction Required from Controllable Sources to Meet Interim TMDLs